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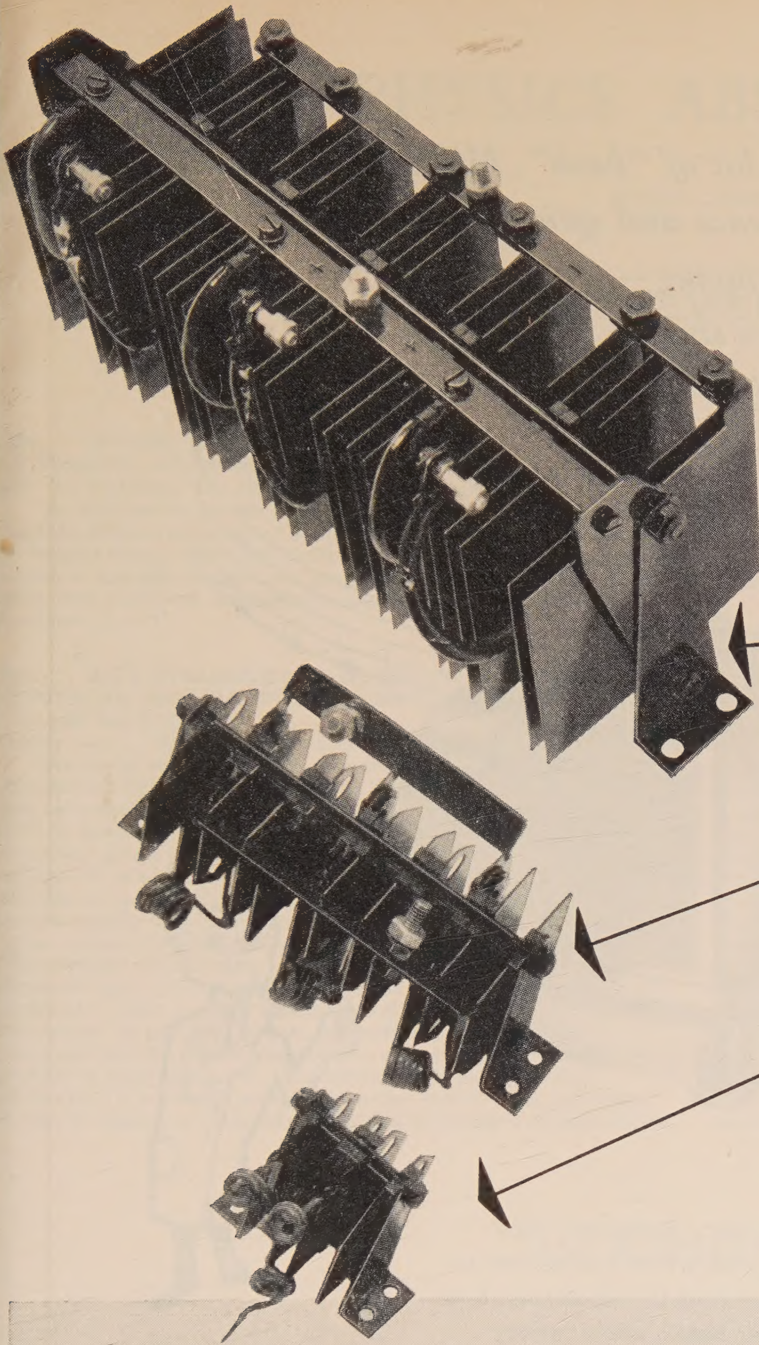

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PHYSICS ABSTRACTS

Volume 62 APRIL 1959 Number 736

MATHEMATICS

518.5 : 531.74

3024. GRATING TANGENTIMETER.

T.E.Thompson, J.L.Oncley and H.Svensson.

Rev. sci. Instrum., Vol. 29, No. 11, 977-8 (Nov., 1958).

The instrument, for the rapid and precise differentiation of graphical data, enables the slope of a tangent to be measured in terms of the tangent angle. Operation of the instrument is based on the production of multiple images by a coarse transmission grating. Under favourable conditions angular measurements may be made with a precision of ±0.1°.

518.5

3025. SOME DYNAMOMETRIC APPLICATIONS OF AN ELECTRONIC INTEGRATOR-DIFFERENTIATOR.

J.Grignet and F.Monfort.

Textile res. J., Vol. 28, No. 1, 47-59 (Jan., 1958).

One of the authors (J.G.) has devised an electronic integrator-differentiator which can be connected to two recorders which will then record in one operation the classical load-extension curve, the work of stretching, and the slope of the load-extension curve. The recorders give a continuous trace from which at any moment can be read off as ordinates the corresponding work of stretching and the rate of loading or rate of extension. The technique can be applied equally well to measurements made by dynamometers on fibres, yarns, rovings, or slivers. Moreover, the integrator-differentiator circuit which is used is also appropriate for many additional uses, since it can be fed by the variable voltage which is produced in many types of apparatus now being widely used in the laboratory. In this way, without any additional work, both the integrated and the differentiated curve can be obtained for whatever function is being measured. The authors have employed this circuit for (1) a critical study of the extent to which the constancy of rate of loading or extension is realized in two yarn dynamometers which have been put on the market recently, and (2) for the continuous measurement of the work of stretching and the rate of loading of wool, nylon, terylene and other fibres when they are being tested on a dynamometer supposed to give a constant rate of extension. Quite apart from the advantage of having the integration and the differentiation proceeding instantaneously, this electronic device also allows a careful investigation of the effect of time in various dynamometric studies of fibres, rovings and yarns.

519.283

3026. MOMENTS OF DISTRIBUTIONS AND THEIR INTERRELATION. J.C.Whitwell and J.H.Wakelin.

Textile res. J., Vol. 28, No. 11, 929-40 (Nov., 1958).

In the field of textile research and processing, variability, both of raw material and of measurements, is unavoidable. It is explicitly implied, therefore, that analysis of data should involve an accounting of the variability and should include considerable information concerning the forms of the distribution encountered. In such a presentation, a knowledge of distribution relationships and interrelationships is of paramount importance. The purpose of this paper is to summarize the relationships between the first few moments of several of the more common types of distributions and to point out a few applications in the analysis of data. Specific problems are in two general categories. First, related distributions, particularly those related by a power of the variable, as with number v. length-biased distributions, will be considered. Second, several problems regarding the sampling of mixed distributions are included. The latter deal with samples from the strata which will comprise the blend or from the blend itself. In each of these situations the effect of single and of bulk samples is treated separately. Finally, some methods of establishing the forms of the distribution are noted for the use of those fortunate enough to be dealing with relatively large numbers of statistics.

ASTROPHYSICS

521.6

3027. ON THE POSSIBILITY OF ELECTROMAGNETIC DAMPING OF THE MOON'S MOTION. O.Jefimenko.

Naturwissenschaften, Vol. 45, No. 23, 566 (1958).

It is estimated that, if the moon were subject to a magnetic field comparable to that of the earth, the rotation damping would be about as strong as that arising from tidal friction. R.A.Newing

522.45

3028. THE LYOT $H\alpha$ HELIOGRAPH AT THE CAPE OF GOOD HOPE. M.A.Ellison.

Nature (London), Vol. 182, 624-6 (Sept. 6, 1958).

One of four similar instruments, the Cape $H\alpha$ heliograph was designed for use on the "solar patrol" organized by the I.G.Y. committee. The instrument is fully automatic, and can photograph the sun in $H\alpha$ light at 1 min intervals throughout the day, using a total length of about 25 ft of 35 mm "Microfile" film. The solar image is maintained central in the film frame to within ±1 to ±2 sec of arc. To prevent film wastage, a "no light" relay switches off the recording camera whenever thick cloud obscures the sun. D.R.Barber

522.58 : 535.315

3029. THE CORRECTION OF DEVIATION ERRORS IN A PRISM SYSTEM FOR A HELIOSTAT. W.Schaefer.

Optik, Vol. 14, No. 5, 221-9 (May, 1957). In German.

In a heliostat, the sun's rays need to be timed through a precise angle. This may be done with a double mirror system, the angle between the mirrors being varied. The author describes a variable prism, which with a special filter, may be used in place of the double mirrors. R.W.Fish

522.6 : 535.215

3030. SOME PROBLEMS ASSOCIATED WITH THE APPLICATION OF ELECTRON-OPTICAL CONVERTERS IN ASTRONOMY.

P.V.Shcheglov.

Astron. Zh., Vol. 35, No. 4, 651-5 (1958). In Russian.

A brief report on work carried out in 1954-1957 at the Shternberg State Astronomical Institute (GAISh), involving application of image converters in photometry and spectroscopy in the i.r. region. Methods of cooling the photocathode and of introducing the high voltage supply are described. S.Chomet

522.6

3031. ON SOME NEW AUXILIARY INSTRUMENTS IN ASTROPHYSICAL RESEARCH. Y.Öhman.

Stockholms Obs. Ann., Vol. 19, No. 4, 3-14 (1956).

A summary of recent instrumental improvements in connection with the solar programme in operation at the Swedish Astrophysical Station, Anacapri, Italy. Some new photometric devices, and accessories, described include a birefringent filter for the Ca II coronal line at 3968 A, an experimental solar monochromator based on the selective magnetic rotation of light passing through a gas confined between crossed polarizers, and a new quadruple-image-prism for solar polarization studies. D.R.Barber

522.61

3032. ON REFLECTION IMAGES IN THE SCHMIDT CAMERA. H.Haffner.

Optik, Vol. 14, No. 7-8, 335-44 (July-Aug., 1957). In German.

Unless the correcting plate is bloomed, unwanted reflections at its surfaces give rise to halation of stellar images. The size and intensity distribution of these concentric halos are calculated and these agree well with those found experimentally. E.A.Mussett

522.61 : 535.245

3033. VISUAL PHOTOMETER FOR STUDYING THE EARTH-LIGHT ON THE MOON. J.Rösch.

Rev. Opt., Vol. 37, No. 9, 458-66 (Sept., 1958). In French.

The design incorporates a novel beam-splitting device which, in conjunction with adjustable neutral wedge, and rotating prism, enables the shadow area of the moon's image to be placed in juxtaposition with an image of the bright portion of the lunar disk whose brightness may be varied. From the position of the neutral wedge when these two images are matched, read on a calibrated scale, the difference of magnitude between the bright and dark portions of the lunar image may be determined to an accuracy of ~ 0.01 magnitude. D.R.Barber

522.611

3034. SOLAR SPECTROSCOPY. O.Mohler.

Science, Vol. 128, 505-10 (Sept. 5, 1958).

A detailed description is given of the construction and use of the McMath–Hulbert vacuum spectroscope of the University of Michigan. Four important features of the instrument are: (1), the use of mirrors instead of lenses to minimise the necessary adjustments when observing in widely separated spectral regions e.g. ultraviolet, and infrared; (2) elimination of image deterioration due to disturbing air currents circulating around the optical system by sealing these components in an evacuated chamber; (3) the use of a specially ruled Babcock grating with resultant low light scatter, and high resolution; and (4) the provision of a small prism spectroscope in fromt of the main entrance slit to act as a monochromator, filtering off unwanted solar light. D.R.Barber

522.612 : 535.89

3035. CONTINUOUS SPECTRUM LIGHT SOURCES FOR SPECTROPHOTOMETRY. H.Kienle.

Optik, Vol. 15, No. 11, 670-5 (Nov., 1958). In German.

Curves are given for relative wavelength–intensity distributions of several sources useful for comparison in stellar spectrophotometry: discharges in H_2 and Xe, tungsten filament and a fluorescent powder, all relative to a carbon arc at 4000°. G.F.Lothian

523.03 : 538.3

HELICOIDAL STRUCTURES IN THE COSMICAL ELECTRODYNAMICS. See Abstr. 2521

523.11

3036. STEADY-STATE THEORY AT CHICAGO. R.Schlegel.

Amer. J. Phys., Vol. 26, No. 9, 601-4 (Dec., 1958).

In papers published in 1918 and 1925 MacMillan suggested that the universe maintains a steady state in its large-scale astronomical features, as a result of a balance between matter-to-energy conversion in stellar interiors and creation of atoms from radiant energy in empty space. No mechanism for the atom-creation process in space was suggested. Millikan used the MacMillan theory as a basis for a theory of the origin of cosmic rays, but in a few years' time accumulating evidence made that theory untenable, and interest in the MacMillan theory then also dropped. Similarities between the MacMillan and Bondi–Gold–Hoyle steady-state theories are noted.

523.11

3037. THE ESCAPE OF STARS FROM CLUSTERS.

III. EXPANSION VERSUS CONTRACTION IN THE EVOLUTION OF A STAR CLUSTER. I.King.

Astron. J., Vol. 63, No. 11, 465-73 (Dec., 1958).

For Pt II see Astron. J., Vol. 63, No. 4, 114-17 (April, 1958). A loose cluster expands as a result of tidal encounters with interstellar clouds, while the ejection of stars causes a dense cluster to contract. The evolution of a cluster of intermediate density can be studied by means of differential equations that follow from the virial theorem and the conservation of energy. The solutions show that the balance between expansive and contractive tendencies is extremely unstable. In practice it is satisfactory to consider a critical radius to divide expanding clusters, to which the pure cloud-encount theory applies, from contracting clusters, to which the pure ejectio theory applies. The critical radius corresponds to the longest possible lifetime for a given number of stars. Present estimates put the critical radius, in the galactic plane, at $1\frac{1}{2}$ pc, with a maximum lifetime of less than 10^9 years for 100 stars, and 3 or 4 × 10^9 years for 1000 stars. A cluster that moves 500 pc above and below the galactic plane has its critical radius doubled and its maximum lifetime tripled. Encounters with field stars also add energy to a cluster, but their effect is always small compared with that of ejection, cloud encounters, or tidal forces. The evolutionary picture given here must give the observed distribution of cluster radii a strong bias in favour of values near the critical radius.

523.112

3038. EFFECT OF EXPANSION OF THE UNIVERSE ON THE DISTRIBUTION OF IMAGES OF GALAXIES ON PHOTOGRAPHIC PLATES — A SIMPLIFIED MODEL. M.Fox.

Astron. J., Vol. 63, No. 7, 266-72 (July, 1958).

A simplified model is presented for the distribution of galaxies in space. This model is used to indicate why and how the method proposed by Neyman, Scott, and Shane (see Abstr. 3825/1953) may be used to check the hypothesis that the universe is expanding.

523.152 : 551.510.53

3039. INTERPLANETARY MEDIUM AND SOME PROBLEMS OF PHYSICS OF THE UPPER ATMOSPHERE. I.S.Shklovskiĭ.

Astron. Zh., Vol. 35, No. 4, 557-71 (1958). In Russian.

The question as to whether interplanetary gas may be considere as a continuation of the solar corona is discussed. It is argued that interplanetary gas is of solar origin and must be "renewed" every 10^3-10^4 years. The ionization of interplanetary gas is considered and it is shown that, owing to the contamination of interplanetary plasma by dust, neutralization of ions on dust particles may be very effective, and may considerably increase the relative number of neutral atoms of hydrogen in interplanetary space. Interplanetary dust particles should be negatively charged and their potential should be of the order of 1 V. Owing to the relatively high abundance of hydrogen in interplanetary medium, solar particles passing through it may take part in charge exchange reactions (e.g. $H^+ + H \rightarrow H + H^+$) so that corpuscular streams eventually contain a considerable number of neutral hydrogen atoms. The latter are unaffected by the earth's magnetic field and may cause phenomena such as polar aurorae illuminated by the sun. Charge exchange reactions may also lead to H_α emission. Finally, the origin of atmospheric helium is discussed. It is suggested that both He^3 and He^4 appear in the terrestrial atmosphere partly as a result of accretion of interplanetary helium. S.Chomet

523.16

3040. SUPRATHERMAL PARTICLE PRODUCTION BY BINARY STARS. D.A.Tidman.

Phys. Rev., Vol. 112, No. 5, 1759-62 (Dec. 1, 1958).

It is suggested that the expanding coronas of binary stars collide and produce a region in violent motion capable of accelerating ions by the Fermi mechanism. This may be important for injecting low-energy cosmic radiation into the interstellar medium.

523.161

3041. GROSS DYNAMICS OF THE INTERSTELLAR MEDIUM. E.N.Parker.

Rev. mod. Phys., Vol. 30, No. 3, 955-62 (July, 1958).

A review, including 56 references, of theories of motions on scales from about 1 to 200 pc. Four methods of estimating the magnetic field along a galactic arm are described: polarization of starlight; the hydrostatic equilibrium condition; coherence of dust clouds; and containment of cosmic rays. All four indicate a field of roughly 0.5×10^{-5} gauss. The energy input into irregular motions of the interstellar gas is considered; it is estimated that neither gravitational instability nor supernova explosions can provide enough energy to maintain the motion, but that newly-formed early-type stars bursting apart a dense gas cloud can. It is argued that the interstellar gas is not turbulent despite the high Reynolds number since otherwise eddy viscosity would quickly damp the non-uniformity of galactic rotation — this lack of turbulence is attributed to the magnetic field. It is also shown how the magnetic field inhibits gravitational instability by reducing the effective value of γ. O.Penrose

523.164.3

3042. RADIO OBSERVATIONS OF THE PLANET JUPITER.

K.L.Franklin and B.F.Burke.

J. geophys. Res., Vol. 63, No. 4, 807-24 (Dec., 1958).

Observations made in June 1954 and 1 November 1955 to 13 March 1956 are reported. Three aspects of the programme are discussed: (1) correlation of observation with the rotation of Jupiter; (2) polarization of the radiation; (3) frequency characteristics. During the period of observation, there were at least three centres of activity on the planet, rotating approximately with the non-equatorial regions. No definite correlation of radio noise with visible features was noted. The white spot DE, noted as a possible correlation in 1951 data, was definitely not well correlated with radio noise occurrences in 1955-56. The most active radio region exhibited a rotational period of $9^h55^m33^s$, a value consistent with other determinations and also consistent with the suggested long-term rotational period, system III. Most of the radio noise bursts were strongly circularly polarized. For the most active region, only bursts of right circular polarization were observed. The radio noise spectrum does not appear to be continuous over the observed set of frequencies. The hypothesis that the narrow angle of visibility is evidence for critical reflection by the ionosphere of Jupiter is not supported by the combined Carnegie and Australian observations.

523.164.32

3043. BURSTS OF SOLAR RADIO EMISSION.

V.V.Vitkevich and Z.I.Kameneva.

Astron. Zh., Vol. 35, No. 3, 372-81 (1958). In Russian.

Presents the results of an analysis of observations conducted in August-September 1956 with a multichannel radio-spectrograph (12 channels covering the frequency range 165-82 Mc/s); these results yielded the following characteristics of the bursts: (1) intensity $1 - 10 \times 10^{-21}$ W $m^{-2}(c/s)^{-1}$; (2) drift velocity of the frequency is 70 (Mc/s)/sec for 200 Mc/s, and 215 (Mc/s)/sec for 100 Mc/s; (3) the duration of the burst is usually (but not always) longer for lower frequencies; (4) the drift velocity is not related to the intensity or duration of radio emission, and (5) no reliable relationship has been found between the bursts and the chromosphere flares.

F.Lachman

523.164.32

3044. RADIO EMISSION FROM THE SUN AT 30 Mc/s.

M.Krishnamurthi, G.S.Sastry and T.Seshagiri Rao.

J. sci. industr. Res., Vol. 17A, No. 12(Suppl.), 71-3 (Dec., 1958).

Tabulated results are presented, for the period 1 May to 31 August 1958, of measurements of enhanced solar radio emission at 30 Mc/s made at the Hyderabad Physical Laboratories of the Osmania University. The intensity of the quiet sun radiation was less than the minimum detectable noise level of the receiver. Of 40 occasions when prolonged enhanced radiation was observed, only 4 cases were associated with solar flares.

D.R.Barber

523.164.32

3045. THE DISTRIBUTION OF BRIGHTNESS AT METRE WAVE-LENGTHS ACROSS THE SUN'S DISK.

R.G.Conway and P.A.O'Brien.

Monthly Not. Roy. Astron. Soc., Vol. 116, No. 4, 386-94 (1956).

A set of interferometer observations were made near sunspot minimum to determine the distribution of brightness across the Sun at wavelengths of 60 cm, 1.4, 3.7, and 7.9 m. At 60 cm, the distribution is completely determined, but at the longer wavelengths the interferometer observations do not determine the distribution in the polar regions. Measurements of the eclipse of 1954 June 30 confirm the distribution at 60 cm, and lead to estimates of the poleward extension at the longer wavelengths. An appendix considers the effect of the limited resolving power of the observations, and shows that no error should result except in any small-scale features of distributions.

523.164.32

3046. THE VARIATION OF DECIMETRE-WAVE RADIATION WITH SOLAR ACTIVITY.

C.W.Allen.

Monthly Not. Roy. Astron. Soc., Vol. 117, No. 2, 174-88 (1957).

A statistical method is used to segregate the quiet component from the slowly varying component of solar decimetre-wave radiation in the period 1947-54. For this purpose the radiations at frequencies 2800, 1200, and 600 Mc/s are correlated with sunspot numbers, sunspot areas, and faculae. The mean lives of the various radiations and activities are estimated and compared. There is an increase of life with decreasing radio frequency. The life of 2800 Mc/s radiation is about the same as sunspots but measurements of the latter show some anomalies. The slowly varying radiation flux is proportional to frequency in the range studied. The quiet sun flux has a small but significant variation with solar activity, the relative change being greater for smaller frequencies. The possibility that this variation may be associated with uncorrelated local sources, such as prominences, is not entirely excluded.

523.164.4

3047. ON THE FREQUENCY OF THE RADIO LINE OF CH MOLECULES.

E.A.Benediktov.

Astron. Zh., Vol. 35, No. 4, 656-7 (1958). In Russian.

CH molecules, which are thought to be present in the interstellar medium, should emit monochromatic radiation near λ 9.5 cm. An attempt is made to calculate the frequency of this line using optical fine structure data for CH molecules. The values obtained are: 3185 ± 60, 3130 ± 65, 3120 ± 95 Mc/s.

S.Chomet

523.164.4

3048. THE SCATTERING OF RADIO WAVES IN THE SOLAR CORONA.

A.Hewish.

Monthly Not. Roy. Astron. Soc., Vol. 118, No. 6, 534-46 (1958).

Observations of the radio emission from the Crab nebula during June, when it passes within a small angular distance of the sun, have shown that the radiation suffers considerable scattering during its passage through the solar corona. An account is given of measurements carried out each year over the period 1952-1958. The following new results have been obtained. (1) measurements at a wavelength of 7.9 m have suggested the presence of refraction effects, in addition to scattering, which may provide information about the mean electron density in the corona; (2) extension of the measurements to the shorter wavelength of 1.9 m has enabled the large scattering at the distance of closest approach to be determined more accurately; (3) a pronounced sunspot-cycle variation has been observed in regions of the corona at a distance of $8R_\odot$; and (4) the scattering has been shown to exhibit anisotropy. This result strengthens the earlier conclusion that the scattering is caused by filamentary irregularities aligned in a magnetic field and suggests that the direction of the field is approximately radial at distances of 15-20 $R_\odot$.

523.164.42

3049. ON THE STATISTICS OF RADIO SOURCES IN RELATIVISTIC COSMOLOGY.

W.Priester.

Z. Astrophys., Vol. 46, No. 3, 179-202 (1958). In German.

A theoretical relation between the cumulative number N of radio sources and apparent radio brightness S is obtained for an expanding model universe with homogeneous distribution of galaxies for euclidean, spherical and hyperbolic metrics. Two distinct cases are considered: (1) a "simple homogeneous source distribution" in which the number of radio sources in each element is proportional to the number of galaxies, and (2) the "collision hypothesis" in which the extragalactic sources are taken to be colliding galaxies. The relation N(S) is exhibited graphically for mass parameters 10^{54} to 10^{57} gm and for the two values 6.5 and 4.0×10^{-18} sec^{-1} of the Hubble constant. The results obtained for cases (1) and (2) show noticeable divergence, but there is little dependence on the type of metric assumed. It is concluded that, in case (1), the observed radiation cannot be explained as emission from normal galaxies, but would require the postulate of some physical process by which a fraction of the galaxies became strong emitters. In case (2), the observed radiation would require an average emission, for each pair of colliding galaxies, slightly less than that observed in the Cygnus-A source.

R.A.Newing

523.164.85

3050. EQUIPMENT FOR RADIO-ECHO OBSERVATIONS OF METEORS WITH AUTOMATIC RECORDING AT THE ENGEL'GARDT ASTRONOMICAL OBSERVATORY.

K.V.Kostylev.

Astron. Zh., Vol. 35, No. 4, 643-50 (1958). In Russian.

The equipment was set up for use during the IGY. It may be used, over long periods of time, for continuous recording of radio-echoes from meteors. The duration of the echoes, the times of transits, and the distances are recorded automatically on a cine-film.

S.Chomet

523.164.85 : 551.557

METEOR-ECHO STUDIES OF UPPER ATMOSPHERIC WINDS.

See Abstr. 3010

523.165

3051. IONIZING RADIATION ASSOCIATED WITH SOLAR RADIO NOISE STORM.

K.A.Anderson.

Phys. Rev. Letters, Vol. 1, No. 9, 335-7 (Nov. 1, 1958).

Consideration of the response of three balloon-borne detectors during a large solar radio noise burst on 22 Aug. 1958, leads to the conclusion that the associated increase in ionizing radiation was due to protons. The event was not accompanied by auroral or magnetic activity.

G.M.Brown

523.34

3052. SIMULATION OF LUNAR CRATERS: A BLOW-HOLE THEORY. A.G.Gaydon and R.C.M.Learner.
Nature (London), Vol. 183, 37 (Jan. 3, 1959).

Blow-holes formed by occluded gas escaping from a powder when evacuated resemble lunar craters. Photographs are shown. It is suggested that volcanic dust, rather than lava, might account for lunar craters. The possibility of C_2 emission being caused by shock waves following sudden release of gas is also considered.
A.G.Gaydon

523.51 : 537.591.3

3053. PRODUCTION OF HELIUM IN IRON METEORITES BY THE ACTION OF COSMIC RAYS. J.H.Hoffman and A.O.Nier.
Phys. Rev., Vol. 112, No. 6, 2112-17 (Dec. 15, 1958).

The helium distribution in a slice from the iron meteorite, Grant, has been measured and plotted in the form of contour maps. The contours of constant helium show a minimum helium content and isotopic ratio, He^3/He^4, near the centre of the slice, the isotopic ratio varying from 0.26 near the centre to 0.30 at the surface. A cosmogenic helium production rate equation was fitted to the data giving a He^3/He^4 production ratio by primary cosmic rays of 0.50 and by secondary particles of 0.14. Primary and secondary particle interaction cross-sections were found to be 540 mb and 720 mb, respectively. The ratio of the average post-atmospheric radius to the pre-atmospheric radius of Grant was calculated to be 0.65.

523.59 : 551.594.51

RECENT STUDIES OF ZODIACAL LIGHT AND SOLAR CORONA. See Abstr. 3018.

523.74

3054. MODEL SOLAR ATMOSPHERE DEDUCED FROM OBSERVATIONS OF LIMB DARKENING. A.Przybylski.
Monthly Not. Roy. Astron. Soc., Vol. 117, No. 6, 600-14 (1957).

A method of correcting model solar atmospheres by comparing the observed limb darkening and the intensities for the centre of the solar disk with same quantities computed theoretically from the model solar atmosphere is described. The differences between the observed and computed quantities are represented as linear functions of the errors in the adopted values of the absorption coefficients and of the variational corrections of the temperature distribution at a number of chosen mean optical depths. The solution of the system of equations obtained in this way gives the corrected values of the monochromatic absorption coefficients and the corrected temperature distribution of the model solar atmosphere. The investigations show that: (i) the observations of the limb darkening may not be free of systematic errors; (ii) the determination of the intensities for the centre of the solar disk are relatively poor, which makes it impossible to obtain reliable corrections for the absorption coefficient; (iii) the structure of the solar atmosphere is affected to a certain extent by convection; (iv) large errors in the values assumed for the absorption coefficient may be counter-balanced by relatively small changes in the temperature distribution; and (v) it seems to be impossible to explain all the results of the observation of solar phenomena without assuming temperature inhomogeneities in the structure of the solar atmosphere.

523.74

3055. LINE ABSORPTION IN THE INHOMOGENEOUS MAGNETIC FIELDS OF SUNSPOTS. W.Mattig.
Z. Astrophys., Vol. 44, No. 4, 280-300 (1958). In German.

The derivation of magnetic field-strength gradient values for sunspot fields from measures of field-distorted line profiles in sunspot spectra is discussed in relation to recently proposed models, e.g. Michard (1953). Field gradients so determined yield probable values of about 1 Oe/km; but there is some uncertainty due to the large range of values obtained by different workers (from 0.4 to 20 Oe/km) depending on the basic method of reduction.
D.R.Barber

523.745 : 537.591

CORRELATION OF COSMIC RAY INTENSITY AND SOLAR ACTIVITY. See Abstr. 2458

523.746

3056. THE ZURICH SUNSPOT NUMBER AND ITS VARIATIONS FOR 1700-1957. E.J.Chernosky and M.P.Hagan.
J. geophys. Res., Vol. 63, No. 4, 775-88 (Dec., 1958).

A compilation of the monthly and annual daily relative sunspot number is given for the years 1749 to 1957. Wolf's annual values are recompiled and given, back to 1700 from 1749. Tabular data include monthly, annual, and moving 11 year means and totals. Times of cycle minima and maxima and appearances of first and last spots are indicated. Graphical presentations are given for the annual, 11 and 22 year means, cycle means and cycle totals, and fo some monthly and five-monthly means. A check for continuation of a relationship of secular change to cycle length is made.

523.755

3057. DEPENDENCE OF THE EQUIVALENT WIDTHS OF CORONAL LINES ON THE DEGREE OF POLARIZATION OF THE CONTINUOUS SPECTRUM OF THE CORONA. Yu.N.Lipskiĭ.
Astron. Zh., Vol. 35, No. 4, 662-5 (1958). In Russian.

Since the continuous spectrum of the solar corona is partly polarized while the line spectrum is not, it follows that a spectrograph will have a different effect on the two types of radiation. A method is described whereby instrumental polarization may be taken into account. The method may also be used in the spectrophotometry of stars.
S.Chomet

523.755

3058. POLAR RAYS OF THE SOLAR CORONA. K.Saito.
Publ. Astron. Soc. Japan, Vol. 10, No. 2, 49-78 (1958).

The polar rays are investigated from observations in 1952, 1954 and 1955 eclipses. They are found to be distributed on the sun' surface in a ring-like zone 10° wide and about 10°-15° distant from the pole. Departure of the curvature of the polar rays from the dipole field is greatest at the corona minimum and becomes less either before or after the epoch. Abundance, lifetime and width are also discussed. Photometry is carried out for eight conspicuous rays and the electron densities in the rays are calculated, giving the value 5.4 times the surrounding space in the corona. Static equilibrium theory of the rays is confirmed. Relationship between the polar rays and polar faculae are throroughly discussed. Epoch of appearance and distribution curves of both phenomena are in the best agreement with each other, suggesting the same origin of both objects.

523.77

3059. THE CENTRE-LIMB VARIATION OF THE SODIUM D LINE INTENSITIES. R.J.Bray.
Monthly Not. Roy. Astron. Soc., Vol. 116, No. 4, 395-412 (1956).

Recent observations of the centre-limb variation of the Na D lines are compared with the earlier observations. Central intensitie found by the different observers agree within the experimental error The new measurements provide no evidence for any centre-limb variation exceeding 1 per cent for points whose residual intensity is greater than 75 per cent. The line cores are formed by coherent scattering, the central intensities being formally accounted for by a value of ϵ of 0.0038 ± 0.0012. Various mechanisms for producing non-zero central intensities are considered.

523.775

3060. THE IDENTIFICATION OF SOME CORONAL LINES.
C.Pecker.
C.R. Acad. Sci. (Paris), Vol. 247, No. 25, 2296-8 (Dec. 22, 1958).
In French.

A clarification of the existing uncertainty regarding identification of coronal lines from computed iso-electronic sequence terms, extrapolated for elements up to 15 times ionized. Several terms not included in Edlen's original calculations (1943) are computed. In particular, new measurements of the equivalent widths of the two emission lines at 5446 A, and 5694 A, favour an identification of this pair with Ca XV. In order to obtain a truly representative model of the corona information is needed from spectra taken in the far ultraviolet and infrared.
D.R.Barber

523.823 : 535.41

3061. MEASURING ARTIFICIAL STAR SEPARATION BY INTERFERENCE. M.J.Pryor.
Amer. J. Phys., Vol. 27, No. 2, 101-3 (Feb., 1959).

Star diameters were originally measured by the Michelson stellar interferometer by varying the separation of mirrors of small aperture which were mounted on a twenty-foot beam. The model here described enables students to obtain values for the separation of artificial stars by interference which are as accurate as measurements obtained by a vernier caliper. It demonstrates a series of diffraction and interference phenomena.

523.85

3062. CONTRIBUTIONS TO THE THEORY OF SPIRAL STRUCTURE. B.Lindblad.
Stockholms Obs. Ann., Vol. 19, No. 7, 14 pp. (1956).

"Dispersion orbits" in the spiral structure of galaxies define elliptical paths along which gas clouds and stellar associations tend to dissolve by differential motion over long periods of time.

A mechanism is outlined whereby symmetrically situated dispersion orbits of Keplerian type may be populated continuously by self-tidal action on matter in the inner regions of the galaxy. The process may be initiated by the presence of either slightly elongated ring or barred-type condensations in the central system. D.R.Barber

523.877

3063. ON THE HYDROGEN CONVECTION ZONE IN STARS OF VARIOUS EFFECTIVE TEMPERATURES AND LUMINOSITIES.

E.Böhm-Vitense.

Z. Astrophys., Vol. 46, No. 2, 108-43 (1958). In German.

The depths and thicknesses of the convection zones are calculated for effective temperatures ranging from 4400° to 8000°, and the temperature and pressure distributions throughout the zones are tabulated, with the help of a mixing-length theory allowing for the interaction between convection and radiative transfer. Convection zones do not develop in the atmospheres of certain hot stars and super-giants. R.A.Newing

525.24

3064. CORPUSCULAR STREAMS DURING THE YEARS OF MINIMUM SOLAR ACTIVITY AND THEIR PROPERTIES.

E.P.Mustel'.

Astron. Zh., Vol. 35, No. 3, 351-65 (1958). In Russian.

A review is given of the author's work on geomagnetic disturbances and their causes. It is argued that separate geomagnetic disturbances and sequences of disturbances during the years of minimum solar activity are caused by the passage of flocculi over the visible centre of the solar disc. The corresponding corpuscular streams are therefore approximately radial. The increase in the time lag and the duration of the disturbances as a minimum of solar activity is approached is ascribed to velocity dispersion in the streams and a decrease in the average velocity. Magnetic field effects are also discussed and it is concluded that in many cases the energy of the "frozen-in" magnetic field of corpuscular condensations can considerably exceed their kinetic energy. It is thought that the intensity of the "frozen-in" field which gives rise to disturbances with non-sudden commencement is 5×10^{-4} Oe, while the field giving rise to disturbances with sudden commencement is 10^{-3} Oe. A critical discussion is given of the "coronal" hypothesis. S.Chomet

525.3

3065. ON THE RETARDATION OF A SATELLITE. R.H.Bacon.

Amer. J. Phys., Vol. 27, No. 2, 69-72 (Feb., 1959).

As the satellite is slowed down by the tenuous upper atmosphere, its period is shortened; the greater the energy losses, the greater the shortening of the period. This surprising result is due to the fact that at the vertices of the elliptic path, the loss of potential energy alone is greater than the loss of total energy caused by any single retarding impulse; a retarding impulse at any point of the satellite's path, therefore, produces at some other point of the path a gain of kinetic energy greater than the loss of total energy at the point at which the impulse was received.

525.3 : 523.164.8

3066. RADIO TRACKING OF EARTH SATELLITES.

D.R.Moorcroft.

Amer. J. Phys., Vol. 27, No. 2, 73-86 (Feb., 1959).

The characteristics of artificial earth satellite orbits are summarized and related to an observer on the surface of the earth. Equations and analytical approaches are developed for determining the orbit of a transmitting satellite using information from equipment for measuring the Doppler shift of the transmitted signal. These are extended to include observations with an array of interferometers (several different arrangements are considered).

525.3

3067. PROBLEMS ON ARTIFICIAL SATELLITES OF THE EARTH. Translated by H.Kruglak.

Amer. J. Phys., Vol. 27, No. 2, 90-4 (Feb., 1959).

Problems suitable for schools on artificial satellites are proposed by four physics teachers in the U.S.S.R. The translated exercises are taken from a series of articles in: Fizika V Shkolye (Physics for schools) 18, 80-4 (May-June, 1958).

525.3

3068. ON THE LIFE-TIME OF AN ARTIFICIAL SATELLITE.

B.Garfinkel.

Astron. J., Vol. 63, No. 10, 422-4 (Nov., 1958).

An approximate formula for the life-time of an artificial satellite is derived under the simplifying assumptions that (1) the resisting force is tangent to the path and is proportional to ρv^2; (2) the density of the atmosphere is an exponential function of the geopotential; (3) the eccentricity of the orbit is small; (4) the oblateness of the earth can be neglected. Application of the result to Sputnik I gives satisfactory agreement with the observed lifetime.

525.3

3069. DEVELOPMENT OF SOME GENERAL THEORIES OF THE ORBITS OF ARTIFICIAL EARTH SATELLITES. T.E.Sterne.

Astron. J., Vol. 63, No. 10, 424-6 (Nov., 1958).

Recent papers by the author have dealt with the effect of atmospheric drag on the orbit of an artificial satellite (Astron. J., Vol. 63, No. 3, 81-7, March, 1958) and with a method for obtaining an approximate perturbed orbit with correct secular motions for an artificial satellite without atmospheric drag (Astron. J., Vol. 63, No. 1, 28-40, Jan., 1958). Progress is reported with further research on both problems.

525.3

3070. A MODIFIED HANSEN LUNAR THEORY FOR ARTIFICIAL SATELLITES. P.Herget and P.Musen.

Astron. J., Vol. 63, No. 10, 430-3 (Nov., 1958).

This paper presents an outline of the modification of Hansen's lunar theory which was devised for dealing with the oblateness perturbations experienced by an artificial earth satellite. The equations are all rigorous, the computations are begun with certain approximations (such as zero or unity), and the iterations are repeated until any desired degree of accuracy is attained. The eccentric anomaly is used as the independent variable. In the orbit plane, the perturbation in the mean anomaly is ΔM, and in the radius vector it is the factor $(I + \nu)$. The orientation of the orbit plane and the ellipse within the plane are defined by θ, ω, or the four "redundant" parameters, λ_1, λ_2, λ_3, λ_4. The ellipse has a fixed semi-major axis and eccentricity.

525.3

3071. OUTLINES OF GENERAL THEORIES OF THE HILL-BROWN AND DELAUNAY TYPES FOR ORBITS OF ARTIFICIAL SATELLITES. D.Brouwer.

Astron. J., Vol. 63, No. 10, 433-8 (Nov., 1958).

A method similar to that of Hill-Brown in the lunar theory is used to obtain a nearly circular orbit for an artificial satellite with arbitrary inclination. The method is essentially the same as that used by Orlov in 1953. For the transition to orbits with arbitrary inclination and small eccentricity a method similar to that employed by Hill for obtaining the motion of the perigee of the moon's orbit is proposed. The weakness of the method is the occurrence of small divisors. The same difficulty arises in the application of other methods similar to methods used in the lunar theory. The exception is Delaunay's method, which promises to yield a completely satisfactory solution.

525.3

3072. SEASONAL ILLUMINATION OF A CIRCUMPOLAR EARTH SATELLITE AT ITS EXTREME-LATITUDE ORBIT POINT.

W.N.Abbott.

Nature (London), Vol. 182, 651-2 (Sept. 6, 1958).

To aid optical tracking of earth satellites following orbits similar to the Russian Sputnik, computed tabulations and plots give: (1) hours of insolation of the point of orbit nearest the pole as a function of the polar distance of the sun, P; and (2) values of P required to give constant insolation at the summit point throughout the entire day as a function of the orbital height of the satellite. For a height of 3247 km all-the-year-round illumination of the satellite at the summit point will occur, neglecting atmospheric refraction. D.R.Barber

525.3

3073. EFFECT OF AIR DRAG ON THE ORBIT OF AN EARTH SATELLITE. D.G.Parkyn; D.G.King-Hele and D.C.M.Leslie.

Nature (London), Vol. 182, 787-8, 788 (Sept. 20, 1958).

Parkyn obtains good agreement between the observed variation with time (over several months) of the period of revolution of satellite 1957β and the variation calculated according to a theory which employs only first-order terms in the eccentricity but includes a correction for the oblateness of the earth. King-Hele and Leslie point out that it is not entirely satisfactory to retain only the oblateness term, since this is one of three small but roughly equal terms in the theoretical formula for the temporal variation of revolution period. G.M.Brown

525.3

3074. A NEW METHOD OF TRACKING ARTIFICIAL EARTH SATELLITES. A.P.Willmore.
Nature (London), Vol. 182, 1008-10 (Oct. 11, 1958).

Brief description of an optical tracking method which employs a system of slits placed in the focal plane of a telescope lens with a photomultiplier behind. A series of pulses is produced as the sunlit satellite image moves across the slits. The performance is in many ways comparable with the Schmidt—Baker—Nunn photographic camera technique, and has the added advantage that a long focal length lens can be used. G.M.Brown

525.3 : 551.510.3

3075. SCALE HEIGHT OF THE UPPER ATMOSPHERE. C.H.Bosanquet.
Nature (London), Vol. 182, 1010-11 (Oct. 11, 1958).

Consideration of the effect of air resistance on the orbit of an artificial earth satellite, including the effect of ellipticity. It is suggested that information about the composition of the atmosphere at various heights may be obtained from determinations of the scale height for satellites having different perigee radii. G.M.Brown

525.3 : 551.510.3

3076. IRREGULARITIES OF SATELLITE DRAG AND DIURNAL VARIATIONS IN DENSITY OF THE AIR. G.V.Groves.
Nature (London), Vol. 182, 1533-4 (Nov. 29, 1958).

It is suggested that the sudden increase in drag observed for three U.S.S.R. satellites at a height of 220 km is due to a heating effect as the precession of the orbital plane carries the perigee fro the night-side to the day-side of the earth. This explanation is an alternative to the assumption that the air density increases considerably at this height. G.M.Brown

525.3

3077. DETERMINATION OF THE ORBIT OF AN ARTIFICIAL SATELLITE. N.Carrara, P.F.Checcacci and L.Ronchi.
Ricerca sci., Vol. 28, No. 7, 1341-55 (July, 1958). In Italian.

525.3 : 550.312

USE OF ARTIFICIAL SATELLITES TO EXPLORE THE EARTH'S GRAVITATIONAL FIELD. See Abstr. 2997.

529.786 : 538.561 : 621.317.39

3078. COMPARISON OF AN AMMONIA MASER WITH A CAESIUM ATOMIC FREQUENCY STANDARD. J.P.Blaser and J.Bonanomi.
Nature (London), Vol. 182, 859 (Sept. 27, 1958).

The ammonia maser at Neuchatel was compared with the N.P.L. caesium resonator by means of the MSF transmissions and the published corrections which are based on the caesium standard. A table of frequency differences, typically about 1 in 10^8, is given. D.Walsh

PHYSICS

GENERAL

3079. LABORATORY COURSES FOR PHYSICS MAJORS. C.A.Plint.
Amer. J. Phys., Vol. 26, No. 8, 553-5 (Nov., 1958).

Some problems associated with the conventional laboratory courses are discussed and details of a new laboratory programme at the University of Oklahoma presented. The new programme has proved highly successful after two year's operation.

53

3080. DESIGN OF EXAMINATIONS AND INTERPRETATION OF GRADES. M.W.P.Strandberg.
Amer. J. Phys., Vol. 26, No. 8, 555-8 (Nov., 1958).

There are two inadequacies of usual teaching methods about which something can be done. The design and evaluation of examinations, as popularly applied, are nonquantitative; and the average student is inadequately prepared for understanding the learning process. Three criteria are presented which may be of use in resolving these difficulties. These criteria are: the concept of logical steps, the concept of avenues of approach, and the concept of the nature of examinations.

53

3081. PLUG-IN BASIC PHYSICS COURSE. R.Hefferlin.
Amer. J. Phys., Vol. 27, No. 2, 95-7 (Feb., 1959).

An extension of Rogers' "block-and-gap" basic physics outline is proposed to include interchangeable blocks. Typical "plug-in units" and combinations of units are listed, and the coverage of essential material is discussed.

53

3082. A STEP AWAY FROM THE CONVENTIONAL LABORATORY IN INTRODUCTORY PHYSICS. H.Laster.
Amer. J. Phys., Vol. 27, No. 3, 166-9 (March, 1959).

A compromise between the extremes of the free laboratory and the conventional laboratory is described. A major feature of this compromise is the requirement that students present two long laboratory reports each semester, in addition to doing a more conventional series of short experiments. Even in the short experiments, students are encouraged to use their own methods of approach to the prescribed topics. The student and faculty response is described. The results justify further exploration along the same lines.

53

3083. SUMMER PHYSICS PROGRAM FOR TALENTED HIGH SCHOOL STUDENTS. J.W.Day.
Amer. J. Phys., Vol. 27, No. 3, 169-71 (March, 1959).

A report on the physics course offered at Texas Technological College during the summer of 1958 for especially gifted high school students.

53 : 531

3084. LABORATORY IN ELEMENTARY MECHANICS. W.E.Hazen, A.G.Dockrill, M.Lapointe and L.Thurston.
Amer. J. Phys., Vol. 27, No. 3, 174-81 (March, 1959).

A new laboratory programme in elementary mechanics is described. Experimental methods have been devised to permit laborator study of nearly all of the basic ideas of dynamics that are studied in the classroom. New instrumentation that proved necessary includes a synchronized timing system accurate to 1/100 sec, a simple stroboscopic camera, and various auxilliary devices. Statics is relegated to the role of a method for determining the forces employed in the dynamics experiments. The programme of experiments is outlined.

53.081

3085. A FEW MORE WORDS ABOUT UNITS. R.L.Mooney.
Amer. J. Phys., Vol. 26, No. 9, 614-18 (Dec., 1958).

The importance of presenting the subject of units and dimensions in a clear and rigorous fashion is re-emphasized in an informal manner in the hope that the comments and observations of the author will be considered further by conscientious teachers of physics in secondary schools and in colleges.

53.084 : 538.31 : 621-526 : 621.317.2 : 621.318.5

3086. IMPROVED MAGNETIC SUSPENSION SYSTEM. C.G.McIlwraith, J.B.Breazeale and E.N.Dacus.
Rev. sci. Instrum., Vol. 29, No. 11, 1029-33 (Nov., 1958).

The apparatus supports a ferromagnetic object free from contact with its surroundings and is capable of maintaining this support for any attitude or orientation in space of the apparatus as a whole. Conditions for stable support are given and features of the system of potential use in instrumentation are described.

53.088.6

3087. ANALOG APPROACH TO THE PROBLEM OF MAKING RESOLUTION CORRECTIONS. J.H.Aitken and W.R.Dixon.
Rev. sci. Instrum., Vol. 29, No. 10, 845-7 (Oct., 1958).

An analogue method is described for computing the Gaussian integral transformation which arises in the problem of making resolution corrections. Only apparatus which is readily available has been used. The basic element is a photomultiplier which views light flashes produced on an oscilloscope screen. A multichannel kicksorter is used to analyse, sum, and record pulses. Making a resolution correction is equivalent to inverting the integral transformation. A trial-and-error procedure is outlined for doing this.

530.1

3088. ELEMENTARY EXPERIMENT IN DERIVING AN EMPIRICAL RELATIONSHIP. F.T.Worrell and M.Correll.
Amer. J. Phys., Vol. 26, No. 9, 607-9 (Dec., 1958).

The experiment described in this paper is intended to illustrate to the student the process of empirical formulation, which is an important step in the development of a physical theory. The physical system used is a bar pendulum pivoted at its upper end. Bars of various lengths are available for a study of the effect of length on period. The results are plotted in various ways, and the law of the system determined.

530.1

3089. ON THE THEORY OF INERTIA OF D.W.SCIAMA AND D.PARK, AND ON THE RELATION OF THE ELEMENTARY LENGTH λ TO THE UNIVERSAL CONSTANTS, c, h, G. O. Costa de Beauregard.
C.R. Acad. Sci. (Paris), Vol. 247, No. 23, 2101-3 (Dec. 10, 1958). In French.

A system of units is proposed such that the law of inertia becomes $F = Im\gamma$, with $I = 2GM/\pi c^2R$, where M is the total mass and R the radius of the spherical Einstein universe. T.R.Carson

GRAVITATION . RELATIVITY

530.12

3090. NEWTON, AND THE CAUSE OF GRAVITY. M.G.Evans.
Amer. J. Phys., Vol. 26, No. 9, 619-24 (Dec., 1958).

Newton attempted to explain the force of gravity on two hypotheses: the existence of a medium, or ether, and action at a distance. The first hypothesis he rejected as being physically absurd, the second as contrary to reason. Newton had, therefore, no theory of gravity. However, his long and sustained effort to understand gravity was not without at least one serious consequence. For involvement in the ether theory obscured from Newton the universal character of the inverse-square relation, and delayed for twenty years his final formulation of the law of gravity.

530.12

3091. RELATIVITY. H.Bondi.
Rep. Progr. Phys., Vol. 22, 97-120 (1959).

The laws of relativity corresponding to Newtonian dynamics are discussed and contrasted with those suited to Maxwell's equations. Einstein's principle of relativity is inferred, and some of its consequences are briefly examined. The peculiar features of Newtonian gravitational theory are described and are shown to lead to the principle of equivalence. The roles of this principle and of the general principle of relativity in the foundations of Einstein's general theory of relativity are critically discussed, and the theory is formulated. Modern developments in the theory are summarized.

530.12

3092. TWIN PARADOX IN SPECIAL RELATIVITY. R.H.Romer.
Amer. J. Phys., Vol. 27, No. 3, 131-5 (March, 1959).

The familiar "travelling twin paradox" is discussed in a particularly simple manner, using special relativity only. The asymmetrical ageing of the twins is predicted using only the relativistic definition of simultaneity and the relativistic time dilatation. Possible objections to such a treatment are discussed.

530.12

3093. ON TIME-DEPENDENT SOLUTIONS OF THE FIELD EQUATIONS IN THE GENERAL THEORY OF RELATIVITY. A.Papapetrou.
Ann. Phys. (Leipzig), Folge 7, Vol. 2, No. 3-4, 87-96 (1958). In German.

The previous work (Abstr. 7673-4/1958) is generalized for an arbitrary time-dependence. It is shown that, independent of the coordinate condition, the boundary conditions at infinity can be satisfied only if both the electromagnetic and the gravitational fields are time-independent in the infinite past and future.

W.A.Hepner

530.12

3094. SHOCK WAVES OF THE GRAVITATIONAL FIELD. H.Treder.
Ann. Phys. (Leipzig), Folge 7, Vol. 2, No. 5-6, 225-35 (1958). In German.

Results derived by Stellmacher, from the theory of characteristics applied to the field equations, are here derived from properties of the Riemannian tensor for Einstein spaces. Stellmacher's two scalar conservation laws, derived as propagation conditions, follow from the divergence-free property of the Riemannian tensor. One of these conservation laws also follows from the equations $t^{\nu}{}_{\mu,\nu} = 0$, where $t^{\nu}{}_{\mu}$ is the energy-momentum pseudo-tensor. The present methods are extended to cover the case of combined gravitational and electromagnetic fields.

R.A.Newing

530.12

3095. REMARKS ON PLANETARY THEORY IN GENERAL RELATIVITY. G.C.McVittie.
Astron. J., Vol. 63, No. 10, 448-52 (Nov., 1958).

Two points in the general relativity theory of planetary motion are discussed: the first is concerned with the identification of ephemeris time within the theoretical framework of general relativity; the second deals with the vexed question of whether or not one can change one's rate of ageing by indulging in space-travel.

530.12

3096. ALGEBRAIC STUDY OF A CERTAIN TYPE OF CURVATURE TENSORS. PETROV'S CASE 3. L.Bel.
C.R. Acad. Sci. (Paris), Vol. 247, No. 23, 2096-9 (Dec. 10, 1958). In French.

It is shown that for a curvature tensor admitting a vector l such that $R_{\alpha\beta,\lambda\mu}l^{\alpha}l^{\lambda} = 0$, $R^*{}_{\alpha\beta,\lambda\mu}l^{\alpha}l^{\lambda} = 0$ (where $R^*{}_{\alpha\beta,\lambda\mu} = \frac{1}{2}\eta_{\alpha\beta\gamma\delta}R^{\gamma\delta}{}_{,\lambda\mu}$) when $R_{\alpha\beta} = 0$, l is necessarily isotropic.

T.R.Carson

530.12

3097. REMARKS CONCERNING A NOTE ON THE GENERALIZATION OF THE SCHWARZSCHILD PROBLEM. T.T.Vescan.
C.R. Acad. Sci. (Paris), Vol. 247, No. 25, 2301-2 (Dec. 22, 1958). In French.

See Abstr. 2117 (1958). The metric is given in corrected form:

$$ds^2 = (c^2 - 2W)dt^2 - c^2(c^2 - 2W)^{-1}dr^2 - r^2d\Theta^2 - r^2\sin^2\Theta\, d\phi^2.$$

R.A.Newing

530.12

3098. ON AN ALTERNATIVE FORM FOR THE FIELD EQUATIONS IN A UNIFIED THEORY OF THE EINSTEIN–SCHRÖDINGER TYPE. L.Bouche.
C.R. Acad. Sci. (Paris), Vol. 247, No. 25, 2302-4 (Dec. 22, 1958). In French.

The action density involving an arbitrary affine connection is replaced by one involving a connection of zero torsion. Certain results are shown to be independent of the relation between these two connections.

R.A.Newing

530.12

3099. ON THE ENERGY–MOMENTUM TENSOR IN THE PERFECT FLUID SCHEMA FOR THE JORDAN–THIRY (UNIFIED) THEORY. A.Surin.
C.R. Acad. Sci. (Paris), Vol. 247, No. 25, 2304-6 (Dec. 22, 1958). In French.

The energy–momentum tensor is taken to be of the form $rv_{\alpha}v_{\beta} - h\gamma_{\alpha\beta}$ in a 5-space with metric $d\sigma^2 = \gamma_{\alpha\beta}dx^{\alpha}dx^{\beta}$, where r and h are positive scalar functions. Expressions for r and h are found in terms of pressure and mass and charge densities.

R.A.Newing

530.12

3100. ON APPARENT LUMINOSITY IN GENERAL RELATIVITY. V.Joseph.
Monthly Not. Roy. Astron. Soc., Vol. 118, No. 6, 631-9 (1958).

A formula for apparent luminosity, valid in an arbitrary space–time, is derived from the conservation equations of the electromagnetic stress–energy tensor for a null field, by the use of optical coordinates and tetrads.

530.12

3101. ON THE ANISOTROPIC CHARACTER OF THE GENERAL RELATIVISTIC SPACE. A.Weissmann.
Nuovo Cimento, Vol. 9, No. 6, 1016-26 (Sept. 16, 1958). In German.

The concept of space is always understood, in accordance with relativity theory, as being real physical space. The physical properties of the latter may then be investigated with the aid of the known geometrical variety. One postulates the relation

$$^*g^{\mu\nu},_{\lambda} + {}^*g^{\alpha\nu}\,{}^*\Gamma^{\mu}{}_{\alpha\lambda} + {}^*g^{\mu\alpha}\,{}^*\Gamma^{\nu}{}_{\alpha\lambda} = 0$$

between the tensor ${}^*g^{\mu\nu}$ and the nonsymmetric connection ${}^*\Gamma^{\lambda}{}_{\nu\mu}$, where ${}^*g^{\mu\nu} = g^{\mu\nu} - \epsilon\phi^{\mu\nu}$, $g^{\mu\nu}$ being the Riemann fundamental tensor, $\phi^{\mu\nu}$ an arbitrary nonsymmetric tensor and $\epsilon \ll 1$. It is shown that the generalized space so defined must be regarded as a deformed Riemannian space, whose "deformation" has no gravitational character.

T.R.Carson

530.12

3102. EINSTEIN'S CONNECTIONS. III. DEGENERATE CASES OF SECOND CLASS. R.S.Mishra.
Nuovo Cimento, Vol. 10, No. 6, 965-84 (Dec. 16, 1958).

The author recently gave the solution of Einstein's first set of equations of unified field theory, by the method of repeated substitution, and obtained the conditions for the existence and uniqueness of the solution for the first two classes of $k_{\lambda\mu}$ and for all indices of inertia of $h_{\lambda\mu}$. The object of this paper is to study the solutions in the singular cases of the second class when these conditions are not satisfied. It is noted that Hlavatý studied the singular solutions both in non-holonomic form and holonomic form. In this paper, the singular solutions are obtained in other holonomic forms using the solution obtained previously for the non-degenerate case.

530.12

3103. SPHERICAL GRAVITATIONAL WAVES. W.B.Bonnor.
Phil. Trans. A, Vol. 251, No. 994, 233-71 (1959).

The field of gravitational radiation emitted from two moving particles is investigated by means of general relativity. A method of approximation is used, and in the linear approximation retarded potentials corresponding to spherical gravitational waves are introduced. As is already known, the theory in this approximation predicts that energy is lost by the system. The field equations in the second, non-linear, approximation are then considered, and it is shown that the system loses an amount of gravitational mass precisely equal to the energy carried away by the spherical waves of the linear approximation. The result is established for a large class of particle motions, but it has not been possible to determine whether energy is lost in free gravitational motion under no external forces. The main conclusion of this work is that, contrary to opinions frequently expressed, gravitational radiation has a real physical existence, and in particular, carries energy away from the sources.

530.12

3104. CONSTRUCTION OF A COMPLETE SET OF INDEPENDENT OBSERVABLES IN THE GENERAL THEORY OF RELATIVITY. A.Komar.
Phys. Rev., Vol. 111, No. 4, 1182-7 (Aug. 15, 1958).

The construction of a complete set of quantities in general relativity, whose functional form is invariant under coordinate transformations, is indicated. The set obtained is highly redundant. The Cauchy problem for obtaining an independent complete set of such quantities ("observables") is therefore discussed. It is also pointed out that the observables obtained may alternatively be viewed as the metric tensor in a special "gauge" (i.e. with a special coordinate condition). This latter viewpoint may facilitate the quantization of general relativity.

530.12

3105. SPACE–TIME STRUCTURE OF A STATIC SPHERICALLY SYMMETRIC SCALAR FIELD. H.Treder.
Phys. Rev., Vol. 112, No. 6, 2127 (Dec. 15, 1958).

Bergmann and Leipnik (Abstr. 9512/1957) have derived some special solutions of the general-relativistic field equations in which the metric has the Schwarzschild or the Minkowski form, although a scalar field is assumed to be present. It is shown that in reality this scalar field vanishes.

530.12 : 530.145

3106. GENERAL RELATIVITY AND PARTICLE DYNAMICS. L.H.Thomas.
Phys. Rev., Vol. 112, No. 6, 2129-34 (Dec. 15, 1958).

In order to adapt the Hamiltonian dynamics of a system of classical (nonquantum) particles to general relativity it seems necessary to generalize the transformations used from contact transformations of phase space to extended point transformation of a joint observer and phase space. When this is done the curvature of observer space is seen to arise from the physical interaction of particles without the introduction of new gravitational field variables. In order to extend this theory to quantized particle and field theory it seems necessary to extend the unitary transformations of quantum mechanics in a similar manner, to linear transformations of matrices maintaining the trace of the product of two matrices, the Hermitian nature of a matrix, and the unit matrix. Such transformations do not preserve the phases of wave functions or the product of two matrices, but do preserve the characteristic values of matrices and the traces of the products of any number of matrices. That observers should be designated by q-numbers, not c-numbers, makes it difficult to interpret the theory except in the classical limit.

530.12

3107. ON THE IDEA OF A CENTRAL AXIS IN THE RELATIVISTIC HYDRODYNAMICS OF ROTATING FLUID MASSES. M.Kléman.
C.R. Acad. Sci. (Paris), Vol. 247, No. 20, 1718-20 (Nov. 17, 1958).
In French.

The existence is established of a relativistic analogue in space-time of the central axis of classical kinematics. The axis is a world line for which $M_{\mu\nu}G^{\mu} = 0$, where $M_{\mu\nu}$ and G^{μ} are respectively the relative angular momentum tensor and the energy–momentum 4-vector. R.A.Newing

FIELD THEORY . QUANTUM THEORY

530.145

3108. QUANTUM MECHANICS AND GEOMETRY. III. M.Schönberg.
An. Acad. Brasil Cienc., Vol. 30, No. 2, 117-31 (1958).

For Pt II, see Abstr. 1036/1959.

530.145 : 539.12

3109. EXPERIMENTAL DEMONSTRATION OF THE NON-CONSERVATION OF PARITY BY MEASURING THE CIRCULAR POLARIZATION OF γ-RAYS. H.Schopper.
Naturwissenschaften, Vol. 45, No. 19, 453-6 (1958). In German.

This is a review article on the experiments indicated in the title and performed mainly by the present author and co-workers. Also general aspects of parity violation and various speculations in connection with these are reviewed. P.Roman

530.145

3110. ADDENDUM TO SPIN, STATISTICS, AND THE TCP THEOREM. J.Schwinger.
Proc. Nat. Acad. Sci. U.S.A., Vol. 44, No. 6, 617-19 (June, 1958).

The connection between spin and statistics is claimed to have a kinematical not dynamical origin; that is, to follow from less assumptions than those of the previous paper (Abstr. 2760/1958). J.C.Taylor

530.145 : 539.12

3111. μ-MESON DECAY AND THE NON-CONSERVATION OF PARITY. B.Jakšić and J.Šoln.
Period. math.-phys. astron. (Zagreb), Vol. 13, No. 2, 125-36 (1958).

The polarization of electrons in μ-decay is calculated for the general parity non-conserving Fermi interaction. The expression for the polarization at all energies and angles involves ten parameters, which are related to the coupling constants. The predictions of the two-component neutrino theory can be found from the general expression. The results are in agreement with those of Kinoshita and Sirlin (Abstr. 5219/1958). G.P.McCauley

530.145 : 538.3

3112. METRICAL CONNECTIONS FOR NON-SINGULAR ELECTROMAGNETIC FIELDS IN VACUO. R.Debever.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 44, No. 6, 549-54 (1958).
In French.

This follows the author's previous note (Ibid., Vol. 42, No. 1, 56-61, 1958). A family of metrical connections associated with non-singular electromagnetic fields in vacuo is determined. It is shown that, in a particular connection, Maxwell equations are expressed in terms of the irreducible components of the torsion tensor. J.Lascoux

530.145

3113. QUANTUM MECHANICS IN GENERALIZED HILBERT SPACE. Vachaspati.
K. Danske Vidensk. Selsk. mat.-fys. Medd., Vol. 30, No. 21, 28 pp. (1956).

An attempt is made to generalize the Hilbert space of quantum mechanics in analogy with the development of the general relativity theory from the theory of special relativity. The state vectors, ψ, $\bar{\psi}$, of quantum mechanics are found to be analogous to the four-velocity, ν^{μ}, of relativity and therefore coordinates, χ, $\bar{\chi}$, are introduced, corresponding to the coordinates x^{μ} of a particle, such that the time derivatives of χ and $\bar{\chi}$ equal ψ and $\bar{\psi}$. The metric η, used in constructing the probability density, is supposed to be a function of χ and $\bar{\chi}$. The unitary transformations of the usual theory are replaced by quite general transformations χ and $\bar{\chi}$. A tensor calculus for this generalized Hilbert space is developed and equations of motion for the states and the dynamical variables are postulated as generalizations of the usual Heisenberg equations when the ordinary time differentiation is replaced by invariant time differentiation. In this way a non-linear theory is obtained. However, the expectation values of the dynamical variables are found to be the same in the new theory as in the old, showing that this theory cannot give any physical results different from those of the usual theory.

530.145

3114. A REMARK ON CONSERVATION RULES. P.Roman.
Nuovo Cimento, Vol. 10, No. 3, 546-50 (Nov. 1, 1958).

The general condition, which ensures that the differential dynamical observables be identical for two equivalent Lagrangians, is deduced and discussed. P.Roman

530.145

3115. ON A POSSIBILITY FOR THE ELIMINATION OF THE NON-PHYSICAL CONSEQUENCES OF THE INDEFINITE METRIC.

K.L.Nagy.

Nuovo Cimento, Vol. 10, No. 6, 1071-7 (Dec. 16, 1958).

Bogoljubov's [Bogolyubov's] method for the elimination of the non-physical consequences of the indefinite metric are analysed. It is proved that this method is equivalent to a very complicated non-local theory in which, however, there is no need to use the indefinite metric and where the usual concepts of quantum theory can be applied. The way of constructing a non-local theory having the usual commutation relations is outlined.

530.145 : 530.12

GENERAL RELATIVITY AND PARTICLE DYNAMICS. See Abstr. 3106

530.145 : 538.3

3116. THE ROLE OF THE LAGRANGIAN IN THE CLASSICAL OR QUANTUM DYNAMICS OF THE ELECTRON.

J.M.Dolique.

Ann. Radioelect., Vol. 13, 200-5 (July, 1958). In French.

Explains how the Lagrangian for a particle moving in an electromagnetic field expresses the Lorentz law for the motion of the particle, and how, in quantum mechanics, the Lagrangian is converted into a wave-equation. It explains also how the potentials which enter into the Langrangian are modified in the transition from the usual electromagnetic field to the meson fields which are responsible for nuclear forces. P.M.Davidson

530.145

3117. EQUATIONS FOR THE GREEN FUNCTIONS IN QUANTUM ELECTRODYNAMICS.

J.Fischer.

Czech. J. Phys., Vol. 8, No. 4, 379-89 (1958).

Using the Freese—Matthews—Salam equations for chronological products of field operators, equations are written for Green functions of many electrons and photons. It is shown that in order to find any single Green function an infinite recursive system of these equations has to be solved. After adding terms containing the external electric current and external electromagnetic potential to the Lagrangian, this system is reduced to one equation containing functional derivatives of higher orders. It is shown that all relations and equations become much simpler when the definition of the Green function is appropriately changed.

530.145

3118. ANALYTIC PROPERTIES OF AN AMPLITUDE OF A PROCESS WITH A CHANGING NUMBER OF PARTICLES.

A.A.Logunov and A.N.Tavkhelidze.

Dokl. Akad. Nauk. SSSR, Vol. 120, No. 4, 739-42 (1958). In Russian.

Having studied the dispersion relations for processes with a variable number of particles in a previous paper (Abstr. 6117/1958) the method of Bogolyubov (N.N.Bogolyubov and D.V.Shirkov, Introduction to the theory of quantized fields, 1957) which uses the theory of functions of a complex variable is applied to prove these relations in the case where an unobservable energy region is absent. The example of the double Compton effect in nucleons is considered in detail. M.J.Kearsley

530.145

3119. A NEW REPRESENTATION FOR BARYONIC FIELDS AND STRONG INTERACTIONS.

B.d'Espagnat.

Nuovo Cimento, Vol. 9, No. 5, 920-3 (Sept. 1, 1958).

By defining fields such as

$$\chi = \tfrac{1}{2}(1 + \gamma_5)N + \tfrac{1}{2}(1 - \gamma_5)i\tau_2\Xi^C,$$

the strong interactions are written so as to fall into two classes. The first class (to be identified with the "very strong" interactions) conserves a new "parity" quantum number; the second class ("moderately strong") contains an extra factor γ_5, and does not conserve this quantum number. J.C.Taylor

530.145

3120. INTERACTION BETWEEN A SMALL AND A LARGE EFFECTIVE HAMILTONIAN, POLARIZATION AND ABSORPTION.

F.Englert.

Nuovo Cimento, Vol. 10, No. 3, 560-2 (Nov. 1, 1958). In French.

An effective Hamiltonian is derived (to second order in the interaction between the two systems) for the small system, a statistical average being taken for the states of the large system. Then, in the small system, the interaction between particles is essentially multiplied by the Fourier transform of the pair correlation function (Abstr. 8679/1954) of the large system at temperature T. For electrons, with Coulomb potential, and neglecting exchange between the two systems, a generalization of the minority carriers results of Pines and Nozieres (Abstr. 2026/1958) is obtained. J.Lascoux

530.145

3121. ON THE RENORMALIZATION OF A PARITY NON-CONSERVING INTERACTION.

K.Sekine.

Nuovo Cimento, Vol. 11, No. 1, 87-101 (Jan. 1, 1959).

An exact formulation is given of the renormalization method in a parity non-conserving theory. Equations determining the renormalization constants are obtained and, among other things, the internal consistency of the theory is examined.

530.145 : 539.12

3122. MASS EFFECT IN P-STATE π-p SCATTERING.

H.Y.Chiu.

Phys. Rev., Vol. 111, No. 4, 1170-3 (Aug. 15, 1958).

The mass difference between charged and neutral mesons was correlated to a change of the pseudovector coupling constant, giving rise to an additional term in the interaction Hamiltonian. The mass effect in P-state π^-—p scattering is then calculated, using Chew's fixed-source theory. A correction to the usual scattering formula for the π^-—p system is obtained. This correction fails to explain the quantitative feature of the observed difference $(\delta_{13}-\delta_{31})$.

530.145 : 539.12

3123. POSSIBLE EXPERIMENTAL TEST OF UNIVERSAL FERMI INTERACTION.

R.Gatto.

Phys. Rev., Vol. 111, No. 5, 1426-30 (Sept. 1, 1958).

The decay modes K_{e3} and $K_{\mu 3}$ of charged and neutral K particles are discussed with the aim of deriving, in the Feynman—Gell-Mann—Marshak—Sudarshan theory, possible experimental tests of the hypothesis of universal Fermi interaction, which is already apparently contradicted by the present data on the ratio of $\pi \to e + \nu$ to $\pi \to \mu + \nu$. Measurement of the K_3 spectra would already provide a test of the hypothesis, and measurements of the polarizations would give further confirmation. Unique forms of the spectra of the charged leptons are predicted on the basis of the universality hypothesis and of particular assumptions.

530.145

3124. APPLICATION OF DIRAC'S OPERATIONAL METHOD TO A SYSTEM OF TWO FERMIONS.

J.Leal Ferreira and A.H.Zimerman.

An. Acad. Brasil Cienc., Vol. 30, No. 3, 281-5 (1958).

An operational method is applied in order to obtain the radial equations for a system of two fermions. For this purpose one employs as constants of motion the total angular momentum $\mathbf{F}^2 = \mathbf{F}(\mathbf{F} + 1)$, the energy and also an operator which is a generalization of Dirac's k operator of the relativistic one-body problem, $k = \beta(\sigma \,.\, 1 + 1)$. The general case requires a representation by 8×8 matrices. In the case $\mathbf{F} = 0$ there exists another constant of motion which allows the use of a 4×4 representation.

530.145

3125. ON THE CLASSIFICATION OF ELEMENTARY FERMIONS.

W.Królikowski.

Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 6, No. 8, 523-7 (1958).

A 4-dimensional isotopic group is used, and some of its representations contain leptons and baryons together. J.C.Taylor

530.145

3126. ON THE GEOMETRICAL FOUNDATIONS OF THE THEORY OF SPINORS IN THREE DIMENSIONS.

M.Morand.

C.R. Acad. Sci. (Paris), Vol. 247, No. 25, 2299-301 (Dec. 22, 1958). In French.

Proposes a new geometrical basis, using an extended definition of plane symmetries in which a sense of rotation is associated with the symmetry plane. R.J.N.Phillips

530.145

3127. QUANTUM NUMBERS FOR A SYSTEM OF NUCLEONS AND ANTI-NUCLEONS.

A.Gamba and E.C.G.Sudarshan.

Nuovo Cimento, Vol. 10, No. 2, 407-9 (Oct. 16, 1958).

A scheme analogous to the Wigner supermultiplet classification of the spin and isotopic spin states of a many-nucleon system is proposed for a system of nucleons and antinucleons. The baryon number is treated as the third component of a "total" baryon number K. This is taken with the isotopic spin I and a suitably defined H in place of the S, T and Y of Wigner. The non-annihilation scattering of antinucleons on deuterons is used to illustrate a possible consequence of the conservation of these new quantum numbers. It is suggested that such quantum numbers might replace the strangeness number in a composite model of the strange particles.

G.P.McCauley

530.145

3128. COVARIANT DESCRIPTION OF SPIN. C.B. van Wyk.
Nuovo Cimento, Vol. 10, No. 5, 854-62 (Dec. 1, 1958).

The most general, finite, proper Lorentz transformation is generated in terms of an infinitesimal transformation. This generator is interpreted as a relativistic spin operator which is capable of describing in a relativistically covariant way the spin and electromagnetic properties of particles with spin $\frac{1}{2}$ and 1 and finite mass. Extensions of the method to particles with vanishing rest mass are indicated.

530.145

3129. ON THE THEORY OF HIGHER SPIN FIELDS. C.Fronsdal.
Nuovo Cimento Suppl., Vol. 9, No. 2, 416-43 (1958).

Reformulates the Fierz—Pauli theory of higher spin fields, treating in detail the structure for arbitrary spin. Magnetic moments of fermions and angular distributions of decay products are among the questions considered. R.J.N.Phillips

530.145

3130. GREEN'S FUNCTIONS FOR PARTICLES OF ARBITRARY SPIN. J.D.Harris.
Phys. Rev., Vol. 112, No. 6, 2124-6 (Dec. 15, 1958).

It is shown that the Green's functions for particles of arbitrary spin are determined by the minimal equation for a certain matrix appearing in the field equations. An explicit expression for these functions is given, which depends on the degree of the minimal equation. An inequality for the degree is presented and it is proved that for particles with multiple, distinct rest masses the Green's functions have no singularities on the light cone.

530.145

3131. DOUBLING OF FERMIONS? M.Goldhaber.
Phys. Rev. Letters, Vol. 1, No. 12, 467-8 (Dec. 15, 1958).

The great similarity between the properties of the μ-meson and those of the electron suggests that they may be two states of the same particle. The author speculates on the possibility that this doubling should be a universal property of fermions. The possible reasons are discussed why a heavy proton could so far have escaped observation, and by what experiments it might be detected.
S.J.Goldsack

530.145 : 539.12

3132. THE MESIC COUPLING CONSTANTS FROM SCATTERING AND PHOTOPRODUCTION EXPERIMENTS.
L.Bertocchi and A.Minguzzi.
Nuovo Cimento, Vol. 9, No. 6, 1107-9 (Sept. 16, 1958).

The difference between the coupling constant as defined by π—N scattering dispersion relations and by the Kroll—Ruderman theorem for threshold photoproduction is calculated in second-order perturbation theory. It is found to be of order $g^2(\mu/M)^2$. J.C.Taylor

530.145

3133. LAGRANGIAN FORMALISM IN RELATIVISTIC HYDRODYNAMICS OF ROTATING FLUID MASSES.
F.Halbwachs, P.Hillion and J.P.Vigier.
Nuovo Cimento, Vol. 10, No. 5, 817-33 (Dec. 1, 1958).

The general theory of relativistic moving fluid masses is studied in terms of a new set of variables originally proposed by Einstein and Kramers. The general equations of motion established directly by Bohm and Vigier (Abstr. 2129/1958) then appear as conservation equations deduced from a scalar Lagrange function of these new variables. This procedure paves the way for a quantization of the internal motion of a model of extended particles in real space: a model strongly suggested by the experimental results of Hofstadter.

530.145 : 539.12

3134. CHARGED MESON—NUCLEON DISPERSION RELATIONS WITH FIXED NUCLEONS. A.Minguzzi.
Nuovo Cimento, Vol. 9, No. 6, 1114-16 (Sept. 16, 1958).

These are derived taking into account the mass difference, $\mu-\mu_0$, between π^+ and π^0, and making a certain approximation for that part of the dispersion integral between μ_0 and μ.
J.C.Taylor

530.145 : 539.12

3135. K^-—NUCLEON SCATTERING WITH TAMM—DANKOFF APPROXIMATION. C.Ceolin, N.Dallaporta and L.Taffara.
Nuovo Cimento, Vol. 10, No. 1, 186-9 (Oct. 1, 1958).

The Tamm—Dankoff approximation in which only the K^-—Y—N interaction is included gives completely wrong results for both scalar and pseudoscalar coupling. When intermediate states involving a pion are included in this calculation, it is found that the Y—π-scattering amplitudes can be eliminated from the equation for the dominant $T = 0, l = 0$ state. This equation is solved numerically and the new terms are seen to be of the opposite sign from the preceding ones, and to be comparable in magnitude. No real conclusions can be drawn from this situation except that pion terms must be included if a calculation of K^-—nucleon scattering is to have any validity. G.P.McCauley

530.145

3136. ON THE DIAGONALIZATION OF WENTZEL'S MODEL.
A.Chevalier and G.Rideau.
Nuovo Cimento, Vol. 10, No. 2, 228-42 (Oct. 16, 1958). In French.

For Wentzel's electron-pair theory see Abstr. 2893 (1942). The quadratic Hamiltonian is diagonalized, and the results discussed according to the different values of the coupling constant. For a whole range of values, one observes a "pathological" behaviour of the Heisenberg operators " which does not seem to admit a simple physical interpretation". The coupling constant renormalization is also considered. J.Lascoux

530.145

3137. NOTE ON TIME-DEPENDENT PERTURBATION THEORY.
I.-T.Wang and T.-Y.Wu.
Nuovo Cimento, Vol. 10, No. 2, 395-7 (Oct. 16, 1958).

The Lippmann—Schwinger formulation of adiabatic perturbation theory is expounded for the case of time-dependent perturbations. A general expression for the wave matrix is given in terms of the Fourier transform of the time-dependent perturbation.
G.P.McCauley

530.145

3138. A COMPARISON OF THE BORN AND THE ASYMPTOTIC W.K.B. APPROXIMATION FOR THE PHASE SHIFT. T.Tietz.
Nuovo Cimento, Vol. 10, No. 3, 553-5 (Nov. 1, 1958).

The validity of the Born and asymptotic W.K.B. approximation is compared for the case of a Thomas—Fermi potential of the nucleus and for the Yukawa potential. P.Roman

530.145

3139. ON THE CONNECTION BETWEEN THE S-MATRIX AND A CLASS OF NON-LOCAL INTERACTIONS. I. K.Chadan.
Nuovo Cimento, Vol. 10, No. 5, 892-908 (Dec. 1, 1958).

The problem of finding a phenomenological separable interaction from the S-matrix was resolved by Gourdin and Martin (Abstr. 5620/1958) who gave exact and explicit formulae relating the interaction to the phase-shift and bound state binding energy. The present author generalizes their method to the case where the interaction is the superposition of a non-local separable interaction and a local one, both of them being central. The local part of the interaction is supposed to be known. It is shown how the separable part can be determined by the S-matrix. Except for a few modifications, the method and results are analogous to those of Gourdin and Martin. The main result is that, given the local part of the interaction, the phase-shift and the bound states binding energies, it is then possible to determine exactly the separable part of the interaction if the phase-shift has a good behaviour.

530.145

3140. ON THE THEORY OF DISPERSION RELATIONS FOR PHOTON—NUCLEON SCATTERING. A.A.Logunov and P.S.Isaev.
Nuovo Cimento, Vol. 10, No. 6, 917-42 (Dec. 16, 1958).

An exact proof of dispersion relations for Compton scattering on nucleons is given. The derivation is obtained following a method suggested by Bogoljubov; only strong interactions are taken into account.

530.145

3141. GENERALIZED DISPERSION RELATIONS.
A.A.Logunov and A.N.Tavkhelidze.
Nuovo Cimento, Vol. 10, No. 6, 943-52 (Dec. 16, 1958).

General dispersion relations for reactions $a + b \to a' + c + d$ are obtained. The possible cases of $(\gamma + p \to 2\gamma + p)$ scattering are indicated, for which dispersion relations do not contain unobservable range of energy.

530.145

3142. ON THE THEORY OF DISPERSION RELATIONS.
A.A.Logunov, S.M.Bilenkij and A.N.Tavkhelidze.
Nuovo Cimento, Vol. 10, No. 6, 953-64 (Dec. 16, 1958).

The dispersion relations for the double Compton-effect in the case of absence of unobservable energy region are proved.

530.145

3143. THE BORN EXPANSION IN NON-RELATIVISTIC QUANTUM THEORY. C.Zemach and A.Klein.
Nuovo Cimento, Vol. 10, No. 6, 1078-87 (Dec. 16, 1958).

Potential scattering of a non-relativistic particle is studied by

530.145

3144. THEOREM FOR GENERALIZED OSCILLATOR STRENGTHS.
S.M.Silverman.
Phys. Rev., Vol. 111, No. 4, 1114-15 (Aug. 15, 1958).

A theorem for generalized oscillator strengths is presented. The theorem should prove useful in the interpretation of experimental and theoretical electronic collision cross-sections.

530.145

3145. MESON EXCHANGE EFFECTS IN TWO-NUCLEON STATES.
R.E.Cutkosky.
Phys. Rev., Vol. 112, No. 3, 1027-38 (Nov. 1, 1958).

It is suggested that the most fruitful study of meson exchange effects requires a unified treatment of all processes in which they occur. A new presentation of the eigenstates of the two-nucleon system, based on the Heitler—London method, is proposed as being particularly useful for this purpose. Heitler—London states have the property that they become equal to the exact eigenstates when the two nucleons are far apart. Matrix elements between Heitler—London states can be expressed in terms of the properties of isolated nucleons, by means of expansions in the number of exchanged mesons. The Heitler—London method affords a mathematically precise method of incorporating phenomenological isobar effects into a field-theoretical model. Most of the discussion of the details of the formalism is confined to the fixed-source model, but in the final part of the paper the application to a more general model is discussed briefly.

530.145 : 539.12

3146. DISPERSION RELATIONS FOR PION—PROTON SCATTERING. D.A.Geffen.
Phys. Rev., Vol. 112, No. 4, 1370-5 (Nov. 15, 1958).

The dispersion relations are used to predict the values, at zero kinetic energy, of the derivatives, $\partial D_{\pm}(0)/\partial k^2$, of the real parts, $D_+(0)$ and $D_-(0)$, of the forward elastic scattering amplitudes for π^+ and π^- mesons scattered by protons. The experimental value of $\partial D_+(0)\partial k^2$ is fairly well known, and, when compared with the predicted value, yields a determination of the coupling constant, $f^2 = 0.104 \pm$ ± 0.014. The predicted value for $\partial D_-(0)/\partial k^2$ disagrees badly with experiment, especially with an f^2 as large as 0.10. The dispersion relations are modified by introducing an extra energy denominator in such a way as to contain, as the additional constants, the derivatives $\partial D_{\pm}(0)/\partial k^2$. This enables one to check the values of $\partial D_{\pm}(0)/\partial k^2$ obtained from the usual dispersion relations as well as the assumption that $\omega^{-2}T_{\pm}(\omega)$ vanishes at infinity. It is found that as long as the agreement with experiment obtained for the π^+ relation is retained, no appreciable change in the values of $\partial D_{\pm}(0)/\partial k^2$ is possible and that the high-energy behaviour of $T_{\pm}(\omega)$, usually assumed, is correct. The predicted value for $\partial D_-(0)/\partial k^2$ strongly suggests a nonzero effective range for α_1 and a relatively large α_{11}.

530.145

3147. PROBLEM OF DISPERSION RELATIONS FOR REACTIONS WITH VARIABLE NUMBERS OF PARTICLES.
A.A.Logunow, A.N.Tawchelidse and N.A.Tschernikow.
Z. Naturforsch., Vol. 13a, No. 8, 642-4 (Aug., 1958). In German.

Dispersion relations are given for the double Compton effect on nucleons ($p + \gamma \rightarrow p + 2\gamma$) and possible cases in which there is no unphysical region are indicated. G.E.Brown

530.145 : 539.12

APPLICATION TO ELECTRON SCATTERING OF CENTRE-OF-MASS EFFECTS IN THE NUCLEAR SHELL MODEL. See Abstr. 2576

530.145

3148. INTEGRABILITY OF THE SCHRÖDINGER WAVE-EQUATION BY SEPARATION OF VARIABLES. C.Agostinelli.
Atti Accad. Sci. Torino, Vol. 92, No. 2, 411-43 (1957-58). In Italian.

The integration of the Schrödinger wave-equation in n variables is considered in general non-orthogonal curvilinear coordinates, and it is shown that a criterion for integrability is that some of the coordinates must be ignorable. In such a case a separation of variables may be made as in the case of orthogonal coordinates, and the separable variables may then be integrated out. For a general space metric with quadratic coefficients the integration of the Schrödinger equation leads to a Riccati-type equation. J.W.Gardner

530.145

3149. RELATION BETWEEN THE DURAND SPIN DENSITY AND THAT OF DIRAC. PHYSICAL INTERPRETATION OF THE RELATION BETWEEN THE INERTIAL TENSOR OF TETRODE AND THE PRODUCT OF THE DIRAC AND GORDON CURRENTS.
O.Costa de Beauregard.
C.R. Acad. Sci. (Paris), Vol. 247, No. 22, 1965-7 (Dec. 1, 1958). In French.

means of the Born series for the Green's function, wave-function, and scattering amplitude. For a wide class of potentials, these series are proved to converge at sufficiently high incident energies. The validity of the Born approximation in the high energy limit is also shown.

530.145

3150. EIGENVALUE PROBLEMS AND THE LIMIT OF THE APPLICABILITY OF PERTURBATION EXPANSION IN AN ANHARMONIC OSCILLATOR. S.Nagata.
Mem. Fac. Sci. Kyusyu Univ. B., Vol. 2, No. 1, 40-5 (March, 1956).

The upper and lower limits of the eigenvalues of the system given by the Hamiltonian $H = \frac{1}{2}\cdot(p^2 + \omega^2q^2) + \lambda q^4$ are obtained by using the suitably modified one for the potential shown above. The conditions whether the power series expansion with respect to the coupling parameter λ is possible or not are discussed.

530.145

3151. USE OF APPROXIMATE WAVE FUNCTIONS FOR EXTRAPOLATION TO TRUE ENERGY VALUES.
P.G.Dickens, J.W.Linnett and D.Schofield.
Nature (London), Vol. 183, 175-6 (Jan. 17, 1959).

It is suggested that for a sequence of approximate wave-functions φ, the mean square deviation Δ of $H\varphi/\varphi$ from its average value E should be plotted against E, a better approximation to the true energy then being obtained by extrapolating to zero Δ. This is tried for two particular cases, and found to be successful when the trial set of functions is based on a complete set which can express the true wave-function. J.Hawgood

530.145

3152. SPECTRAL REPRESENTATIONS IN PERTURBATION THEORY. I. VERTEX FUNCTION.
R.Karplus, C.M.Sommerfield and E.H.Wichmann.
Phys. Rev., Vol. 111, No. 4, 1187-90 (Aug. 15, 1958).

The vertex operator is examined in lowest order perturbation theory. It is found that, as a function of the invariant momentum transfer $q^2 = \vec{q}^2 - q_0^2$, it is analytic in a cut plane with the branch point on the negative real axis. A spectral representation (dispersion relation) may therefore be inferred. The threshold of the spectrum depends on the masses of all fields involved unless certain inequalities hold between the masses of the incident and outgoing particles on one hand and the particles in intermediate states on the other; in that case the threshold depends only on the intermediate masses.

STATISTICAL MECHANICS

TRANSFER PROCESSES

530.145

3153. THEORY OF RADIATIVE DAMPING IN STATIONARY STATES. C.A.Mead.
Phys. Rev., Vol. 112, No. 6, 1843-7 (Dec. 15, 1958).

A formalism is developed for finding the stationary states of systems for which radiative damping effects must be considered. The method includes a criterion for deciding whether or not a given unperturbed state has an exact stationary state corresponding to it. The method is applied to a simple example, the Lee model with unstable V-particle, and it is indicated how more complicated problems may be treated.

530.162

3154. NEW LOOK AT VON NEUMANN'S OPERATOR METHOD IN QUANTUM STATISTICS. II. W.Band.
Amer. J. Phys., Vol. 26, No. 8, 540-8 (Nov., 1958).

For Pt I see Abstr. 1096/1959. The quantum-mechanical equation of change with time is applied to an ensemble, and the quantum-mechanical analogue of the classical Liouville theorem is derived. The conflict between the quantum-mechanical equation of change of an isolated system, and the second law of thermodynamics is explained. The connection between entropy and the uncertainty principle and the effect of measurement on entropy are discussed in detail. It is pointed out that in quantum mechanics, the uncertainty principle forbids the complete specification of the boundaries of a truly isolated system. The effects of random disturbances at the boundary, within the limits permitted by the uncertainty principle, are shown to cause a rapid spontaneous approach to maximum entropy of any "isolated" system. Applications to quasi-stationary irreversible effects are briefly discussed, and it is indicated how the concept of random fluctuations of the boundary leads to a deduction of the Fokker—Planck equation for irreversible processes.

530.162

3155. PARTITION FUNCTION OF AN IMPERFECT BOSE–EINSTEIN GAS (PROBLEM OF LIQUID HELIUM). J.Peretti.
C.R. Acad. Sci. (Paris), Vol. 247, No. 23, 2099-101 (Dec. 10, 1958). In French.

Using Montroll and Ward's method of "torons" (Abstr. 5665/1958), the grand partition function of a gas of hard Bose spheres is calculated to first order in the sphere radius. O.Penrose

530.162

3156. APPLICATION OF THE MONTE CARLO METHOD TO THE LATTICE-GAS MODEL. I. TWO-DIMENSIONAL TRIANGULAR LATTICE. Z.W.Salsburg, J.D.Jacobson, W.Fickett and W.W.Wood.
J. chem. Phys., Vol. 30, No. 1, 65-72 (Jan., 1959).

The Monte Carlo numerical method for obtaining statistical mechanical averages in the petite canonical ensemble is applied to the two-dimensional triangular lattice-gas model. The Monte Carlo procedure described by Rosenbluth et al. and by Wood and Parker is extended slightly to include the calculation of the partition function. The results are compared with the exact solutions for the two-dimensional lattice and the agreement is well within the fluctuation displayed by the numerical method. The calculations are found to be relatively insensitive to a change in the pseudo-random number sequence and to display no exceptional behaviour in the region of the first-order phase transition for small lattices.

530.162

3157. AN APPLICATION OF IRREVERSIBLE THERMODYNAMICS TO THE STUDY OF DIFFUSION. R.W.Laity.
J. phys. Chem., Vol. 63, No. 1, 80-3 (Jan., 1959).

An attempt is made to show the usefulness of irreversible thermodynamics in permitting the definition of new terms by which the rates of dynamic processes may be characterized. A set of rate constants with which to describe simple mass diffusion is discussed and is shown to be potentially more useful than some of the phenomenological coefficients employed in other treatments of diffusion. The coefficient under discussion represents the proportionality between the thermodynamic force on a substance and its velocity relative to another substance in the mixture, and is therefore termed a "friction coefficient". How such coefficients may be determined for some simple systems is explained, and examples are cited from the literature. It is suggested that these may be more useful quantities than more conventionally defined diffusion coefficients upon which to focus attention in the search for microscopic models to explain the mechanism of diffusion processes.

530.162

3158. MOLECULAR DISTRIBUTION IN BOSE–EINSTEIN AND FERMI–DIRAC GASES. K.Ikeda.
Mem. Fac. Sci. Kyusyu Univ. B., Vol. 2, No. 2, 51-63 (Nov., 1956).

For the ideal Bose–Einstein and Fermi–Dirac gases, exact expressions are obtained of the reduced molecular distribution functions $n_\mu \{\mu\}$ (for every finite number μ of molecules of explicit coordinates) as power series in the fugacity z (or in the density $1/\nu$). The method used is similar to that of Mayer–Montroll for classical gases. The functions obtained describe the molecular distribution due to the correlations in position space between force-free molecules, caused by the exchange effects.

530.162

3159. SOME REMARKS ON THE QUANTUM MECHANICS OF A LATTICE GAS. J.Czerwonko.
Nuovo Cimento, Vol. 10, No. 4, 730-3 (Nov. 16, 1958).

It is shown that two non-equivalent Hamiltonians for the lattice gas arise from the expressions $\nabla\psi^*.\nabla\psi$ and $\psi^*\nabla^2\psi$ which are equivalent in the continuous case. J.Hawgood

530.162 : 533.7

3160. THE STATISTICAL MECHANICAL BASIS OF THE ENSKOG THEORY OF TRANSPORT IN DENSE GASES.
J.G.Kirkwood and S.A.Rice.
Nuovo Cimento Suppl., Vol. 9, No. 1, 112-14 (1958).

The expression for shear viscosity is identical with, and for thermal conductivity is only slightly different from that of Enskog. The calculations made (not given) use distribution functions coarse grained in time, but there is some doubt as to the validity of identifying macroscopic observables with these averages. P.Gray

530.162 : 532.7

3161. THE TRANSPORT PROPERTIES OF DENSE ASSEMBLIES OF RIGID SPHERES. H.C.Longuet-Higgins.
Nuovo Cimento Suppl., Vol. 9, No. 1, 115 (1958).

A general method is described for the calculation of transport coefficients in dense fluids composed of rigid spheres. It is assumed that for uniform concentrations the spatial distribution function has its equilibrium value, but that the velocity distribution is a product of Maxwellian single-particle functions chosen to give correctly the local temperature and hydrodynamic velocity. The following assemblies are investigated: (1) The single-component assembly of smooth rigid spheres for which the shear and bulk viscosities, the thermal conductivity and the self-diffusion coefficient are calculated explicitly. (2) The two-component mixture of spheres of different mass and the same radius; for this assembly the heat and matter transport coefficients are calculated and are found to satisfy Onsager's theorem. (3) The multi-component assembly. The diffusion constants are calculated and are also found to satisfy Onsager's theorem. (4) The one-component assembly of rough spheres. The viscosity and thermal conductivity are found to be greater than in the smooth sphere assembly. (5) A one-component assembly of spheres each of which possesses two internal energy levels, excitable by collision. For this assembly a formula is obtained for the absorption of sound at high frequencies.

530.162

3162. QUANTUM STATISTICS OF INTERACTING PARTICLES. E.W.Montroll and J.C.Ward.
Nuovo Cimento Suppl., Vol. 9, No. 1, 235-6 (1958).

See Abstr. 5665 (1958), which refers to a complete account of this work.

530.162

3163. A GENERALIZATION OF MACDONALD'S INVERSION THEOREM. F.N.M.Robinson.
Phil. Mag. (Eighth Ser.), Vol. 3. 909-11 (Aug., 1958).

MacDonald's Inversion Theorem gives the power spectrum of a quantity X(t) fluctuating in time. The present paper extends this to the case of the product X(t)Y(t) of two such quantities. The existence of an integral occurring in the theorem is also investigated. N.L.Johnson

530.162 : 621.391

3164. THE SPECTRUM OF LIMITED GAUSSIAN NOISE. F.L.H.M.Stumpers.
Philips Res. Rep., Vol. 13, No. 6, 509-14 (Dec., 1958).

The energy spectrum of the output of a non-linear device with an input of Gaussian noise can be expressed directly in terms of the Laplace transform of its characteristic and of convolutions of the input bandpass form. The expression is derived and the result applied to several forms of limiter characteristic. The same method can be applied if a carrier signal is also present. The amplitude of the carrier wave after limiting and the energy spectrum of the output noise are also calculated.

530.162

3165. APPROACH TO EQUILIBRIUM. B.A.Green, Jr.
Phys. Rev., Vol. 112, No. 4, 1053 (Nov. 15, 1958).

Frisch (Abstr. 525/1958) has shown that certain properties of certain isolated physical systems approach equilibrium values in time. The present paper strengthens Frisch's result by showing that under the same conditions all observable properties, including a suitably defined phase density function, approach equilibrium values in time.

530.162

3166. ON THE ENUMERATION OF MAYER CLUSTER INTEGRALS. H.N.V.Temperley.
Proc. Phys. Soc., Vol. 72, Pt 6, 1141-4 (Dec., 1958).

The enumeration is carried out for the case of the number of lines being close to the number of molecules, by series solution of a transformation of the differential equation satisfied by the generating function for the cluster integrals. Certain results of Abstr. 1276 (1954) are verified and generalized. J.Hawgood

530.162

3167. CONTRIBUTION TO THE THEORY OF BROWNIAN MOTION. R.W.Zwanzig.
Phys. of Fluids, Vol. 2, No. 1, 12-19 (Jan.-Feb., 1959).

The classical theory of Brownian motion of a periodic system is generalized to include the case where the period of the system is very short compared with times characteristic of its interaction with the environment. The system is described in terms of action and phase variables, which are constants of the motion in the absence of interactions. The probability density of the system, averaged over a time which is very long compared with a period of the motion, and long enough to include many interactions, is shown to be a solution of a Fokker–Planck equation in action-phase variables. Conditions for this are that the interaction is sufficiently weak and that the environment remains in thermal equilibrium. Explicit expressions for the friction coefficients are obtained. When the probability density of the system is independent of its phase, its irreversible behaviour can be described as a random walk in action space. This is a reasonable classical analogue to the quantum-statistical description by means of the Pauli equation. The properties of a harmonic oscillator with a special interaction are considered in detail; it is shown that the friction coefficients are proportional to the spectral density of a fluctuating force associated with the interaction, evaluated at the frequency of the oscillator.

530.162

3168. FORMAL SOLUTION OF THE EQUATIONS OF STATISTICAL EQUILIBRIUM. B.Zumino.
Phys. of Fluids, Vol. 2, No. 1, 20-2 (Jan.-Feb., 1959).

A closed expression is given for the distribution functions in the classical theory of statistical equilibrium. This expression, when suitably expanded, permits one to obtain rather simply the general term in the virial expansion of the distribution functions and of the equation of state.

GENERAL MECHANICS

MECHANICS OF SOLIDS

531 : 53

LABORATORY IN ELEMENTARY MECHANICS. See Abstr. 3084

531.231

3169. MOMENTS OF INERTIA OF SKELETON FIGURES AND SHELLS. J.Satterly.
Amer. J. Phys., Vol. 27, No. 3, 172-3 (March, 1959).

Theoretically a skeleton figure can have no mass but for purposes of calculation the edges are assumed to have uniform linear density. Skeleton triangles are considered first followed by a summary for skeleton rectangles, polygons, polyhedra, hollow cones, spherical caps, anchor rings, and ellipsoids. The formulae quoted have been checked by experiments with models.

531.24 : 516

3170. CENTROIDS OF NEGATIVE MASSES AND WEIGHTED VECTORS. S.I.Askovitz.
Amer. J. Phys., Vol. 26, No. 9, 610-13 (Dec., 1958).

The concept of centroids can be extended to include negative masses by following the formulae of analytic geometry. However, when the sum of the masses is exactly zero, the familiar equations fail, and a new definition becomes necessary. In order to be consistent, the "centroid" in such a case may be defined as a vector. To facilitate working with this "centroid vector", a weighting factor may be attached to the vector. An application of these "generalized centroids" to a problem in least squares is given.

531.258 : 536.21

3171. TWO-DIMENSIONAL THERMAL STRESSES DUE TO STEADY HEAT FLOW IN A SEMI-INFINITE AEOLOTROPIC PLATE. P.Choudhury.
J. Technol. (Calcutta), Vol. 3, No. 1, 19-24 (June, 1958).

531.258 : 534.121

3172. EQUILIBRIUM, BUCKLING AND VIBRATION OF A 30° 60°-90°-TRIANGULAR PLATE SIMPLY SUPPORTED AT THE EDGES. Pan Lih-chow.
Scientia Sinica, Vol. 6, No. 3, 347-79 (June, 1957).

The fourth order equation for the bending of an elastic plate is reduced to two simultaneous second order equations, each of which can be interpreted in terms of the deflection of a membrane. The deflection of a 30°-60°-90° triangular membrane under a uniform normal load is found in terms of a single trigonometric series. This solution is achieved by a "method of images" whereby the triangle appears as part of a suitably loaded rectangular membrane. This result is used to obtain a single series solution for the deflection of a 30°-60°-90° triangular plate with simply supported edges under a uniform normal load. An alternative double series solution is then found, but this is not so rapidly convergent as the single series. The double series solution is finally extended to include the addition of forces acting uniformly along the boundary and used to find the modes of vibration when the uniform normal load is absent. A.E.I. Research Laboratory

531.3 : 795.4

3173. ON THE ANALOGY BETWEEN DYNAMICS AND A GAME OF CARDS. P.J.van Heerden.
Amer. J. Phys., Vol. 27, No. 2, 103-11 (Feb., 1959).

It is shown that there is an analogy between dynamics and a simple game of cards. The dynamical quantities like velocity, mass, momentum, and kinetic and potential energy find their equivalents in the card game.

531.38

3174. INDUCED ROCKING. J.Satterly.
Amer. J. Phys., Vol. 26, No. 9, 625-7 (Dec., 1958).

Circular objects such as disks fitted with central spindles rest on a horizontal table in inclined positions which are in neutral equilibrium. If the disk is loaded eccentrically with a small body the disk will rest in stable equilibrium when that body is in its lowest position. If the whole is displaced to one side and released it will rock to and fro about that position. Theory and experiment are applied to find how the period of the rocking motion depends on the dimensions of the disk, spindle, and affixed body, the inclination of the spindle to the horizontal, and the masses and moments of inertia of disk, spindle, and affixed body. The expression found for the length L of the equivalent simple pendulum is $L = I\cos\rho/ma$, where I is the total moment of inertia of disk, spindle, and affixed body about the line joining the points of contact of the spindle and the disk with the table, ρ is the angle of inclination of the spindle to the horizontal, m is the mass of small affixed body, and a is the distance of the centre of this body from the axis of the disk and spindle.

531.577

3175. CRATER FORMATION IN METALLIC TARGETS. W.S.Partridge, H.B.Vanfleet and C.R.Whited.
J. appl. Phys., Vol. 29, No. 9, 1332-6 (Sept., 1958).

Spheres of copper, lead, tin, iron, aluminium, zinc, silver, and lead–tin alloys were accelerated to velocities of 0.75 to 2.25 km/sec and impacted normally upon targets of the same material as the pellets. Conditions were maintained so that pellets lost no mass before striking the target. The target mass was large compared to the mass of the pellet, so the targets could be considered semi-infinite. The volume of the crater produced was found to be directly proportional to the kinetic energy of the pellet in the energy range investigated. The penetration varied linearly with the velocity or momentum of the pellet. The area of the crater as measured in the plane of the original surface of the target was found to be directly proportional to the momentum of the pellet at the time of the impact. In the case of the lead–tin alloy series, a correlation was observed between the crater parameters, the phase diagram of the alloys, and various functions of the pellet mass and velocity for the following series of alloys: 100% lead; 90% lead, 10% tin; · · · ; 10% lead, 90% tin; 100% tin.

MECHANICAL MEASUREMENTS

531.717.7 : 535.417

3176. PRECISION MEASUREMENTS WITH THE RING SPHEROMETER. K.Rosenhauer.
Optik, Vol. 14, No. 7-8, 328-34 (July-Aug., 1957). In German.

An analysis of the errors introduced by differences in height between the internal and external radius of the ring of the spherometer. The difference in height is demonstrated interferometrically on a particular instrument, using multiple-beam interference. It is shown how correction can be secured with optical calibration. S.Tolansky

531.74 : 518.5

GRATING TANGENTIMETER. See Abstr. 3024

531.753 : 545.1

3177. GAS CIRCULATING APPARATUS CONTAINING A MAGNETIC BALANCE. L.C.Scala, W.M.Hickam and A.Langer.
Rev. sci. Instrum., Vol. 29, No. 11, 988-90 (Nov., 1958).

A gas circulating system is described in which a sample undergoing thermal decomposition can be weighed continuously by means of a magnetic balance having a sensitivity of the order of 0.1 mg. Changes of composition in the gases contained in the system are determined by withdrawing samples directly into a mass spectrometer for analysis. Accurate quantitative measurements of the uptake and evolution of gases during the degradation process are thus obtained, providing an insight into the reactions that occur. It is thought that this simple system should prove useful in many other fields of investigation.

531.754.5

3178. A SIMPLE METHOD OF DENSITY MEASUREMENT FOR AIR-CONTAINING ICE SPECIMENS. W.Ambach.
S.B. Osterr. Akad. Wiss. mat.-nat. Kl. Abt. II, Vol. 165, No. 1-4, 127-31 (1956). In German.

A pyknometer with an accuracy of 0.2% is described and values of density between 0.86 and 0.91 g/cm^3 were obtained for Alpine ice. J.M.Hough

531.787.7 : 539.17

3179. DIFFERENTIAL PRESSURE GAUGE FOR USE WITH LIQUIDS AND CORROSIVE FLUIDS.
H.E.Flotow, B.M.Abraham and R.D.Carlson.
Rev. sci. Instrum., Vol. 29, No. 10, 869-70 (Oct., 1958).

A sensitive, rugged pressure gauge has been developed to determine the density (composition) and the viscous pressure loss in flowing streams of UO_2-NaK slurries. The differential pressure sensors are two metal bellows that are rigidly connected in opposition, the net displacement of which is detected by a linear variable differential transformer. The sensitivity of the unit is 0.05 mm Hg pressure and the range is 100 mm Hg with an accuracy of ±0.4%. By simply inserting various calibrated springs in the instrument it is possible to increase or decrease the range and maintain the sensitivity at 0.05% of the range.

MECHANICS OF FLUIDS

532.1

3180. TENSILE STRENGTHS OF LIQUID ARGON, HELIUM, NITROGEN AND OXYGEN. J.W.Beams.
Phys. of Fluids, Vol. 2, No. 1, 1-4 (Jan.-Feb., 1959).

The tensile strengths of several liquids at low temperature were measured by a linear deceleration method. The values found were as follows (expressed in atm): argon −12, nitrogen −10, oxygen −15, and helium −0.16. The values are somewhat lower than those calculated from the theory.

532.13

3181. CORRECTION FOR STOKES' LAW.
N.R.Gokhale and K.M.Gatha.
Indian J. Phys., Vol. 32, No. 11, 521-4 (Nov., 1958).

Millikan's correction to Stokes' law for water droplets falling through air has been measured. Some necessary improvements over Millikan's method have been introduced. The present direct measurement yields the value A = 0.701 for the relevant correction constant.

532.133

3182. CAPILLARY VISCOMETRY OF DISPERSIONS.
S.Nakanishi and T.Yanagawa.
Doshisha Engng Rev., Vol. 8, No. 1, 19-23 (May, 1957).

532.133

3183. VISCOSITIES OF SOME UNDERCOOLED LIQUID ALKYL HALIDES. D.J.Denney.
J. chem. Phys., Vol. 30, No. 1, 159-62 (Jan., 1959).

The viscosities of i-butyl bromide, i-amyl bromide, and i-butyl chloride were measured over a temperature range in which η changes from 10^2 poise to about 10^8 poise. The temperature dependence of η is very close to that of the dielectric relaxation time τ indicating the similarity of the molecular processes involved. This similarity thus appears to apply to "nonassociated" polar liquids as well as to hydrogen bonded liquids.

532.133

3184. VISCOSITIES OF LIQUID MIXTURES.
T.M.Reed, III and T.E.Taylor.
J. phys. Chem., Vol. 63, No. 1, 58-67 (Jan., 1959).

The viscosities of ten binary liquid systems were determined as a function of composition and of temperature in the range from 25° to 45°C. The thermodynamics of these systems range from the ideal solution to partially miscible liquids. The free energy of mixing alone is insufficient thermodynamic information in attempting to correlate the thermodynamic behaviour with the viscosity behaviour of solutions. The volume change on mixing and the entropy of mixing each are related to separate viscosity effects. Based upon the absolute reaction rate theory of Eyring these systems have been divided into three classes which differ in the dependence of the temperature coefficient of viscosity on temperature. It is found that as the temperature is decreased to approach the two liquid phase region of a mixture, the viscosity as a function of composition displays an abnormally high value. This effect is found at 22° above the critical unmixing temperature for the system composed of isoöctane and perfluoroheptane. This analysis shows that the enthalpy of activation for all solutions may be considered as essentially independent of temperature even though the temperature coefficient of viscosity varies with temperature.

532.133

3185. THE VISCOSITY OF CONCENTRATED AQUEOUS SOLUTIONS OF SODIUM CHLORIDE.
C.V.Suryanarayana and V.K.Venkatesan.
Trans Faraday Soc., Vol. 54, Pt 11, 1709-11 (Nov., 1958).

The viscosities of aqueous solutions of sodium chloride from 1 modal to saturation and from 30° to 55°C were measured. They are interpreted in terms of the ratio (C*) of the mole fraction to that at saturation at the same temperature and the corresponding ratio $\eta/\eta_{sat} = \eta^*$, i.e.

$$\eta = \eta_{solvent} \exp[BC^*],$$

where B is a constant. The published data for potassium chloride are also examined.

532.14

3186. RADIATION ATTENUATION METHOD OF MEASURING DENSITY OF A TWO-PHASE FLUID. M.Petrick and B.S.Swanson.
Rev. sci. Instrum., Vol. 29, No. 12, 1079-85 (Dec., 1958).

A gamma-ray attenuation technique is described for measuring density and phase distribution in a two-phase fluid. A comparison is made between a "one-shot" and traverse method. The technique was evaluated on Lucite mock-ups of simulated flow patterns encountered in two-phase flow and by a series of tests on an air-water system at atmospheric pressure.

532.5 : 539.217

3187. ASYMMETRY OF THE CONCENTRATION FRONT DURING MISCIBLE DISPLACEMENT IN POROUS MEDIA.
A.E.Scheidegger and V.C.Larson.
Canad. J. Phys., Vol. 36, No. 11, 1476-82 (Nov., 1958).

During many feasible experiments concerning miscible displacement in porous media, it has been noted that the concentration front is slightly asymmetric. It is possible that this is due to an asymmetry in the boundary conditions which is present in most practicable displacement experiments. The present paper endeavours to investigate the influence of asymmetric boundary conditions upon the shape of the concentration front. The diffusivity equation basic to the theory of miscible displacement was solved for the case of injection of fluid of constant concentration at one end of a long, linear porous medium. The solution was effected by an electrical analogue computer. Curves showing the asymmetry are given.

532.5 : 530.145 : 536.48

QUANTUM HYDRODYNAMICS. He II THEORY.
See Abstr. 2272

532.517

3188. HEIGHT OF FALL VERSUS FREQUENCY IN LIQUID ROPE-COIL EFFECT. G.Barnes and J.Mackenzie.
Amer. J. Phys., Vol. 27, No. 2, 112-15 (Feb., 1959).

When height of fall is plotted against frequency of coiling in the liquid rope-coil experiment (see Abstr. 3756/1958) a straight line relationship that does not pass through the origin results. A correction due to the effect of surface tension on the stream of falling liquid yields "effective" heights of fall which, when plotted against the rate of coiling, does result in a straight line through the origin.

532.517.4

3189. TEMPERATURE FLUCTUATIONS IN AN ISOTROPIC TURBULENT FLOW. Y.Ogura.
J. Meteorol., Vol. 15, No. 6, 539-46 (Dec., 1958).

The methods of Heisenberg are applied to isotropic temperature fluctuations in a stationary isotropic turbulence, under the restriction that temperature differences are too small to have any effect on the velocity field. The power spectrum for temperature fluctuations, thus deduced, degenerates to those obtained previously by Corrsin at two extremes: in intermediate and highest wave-number ranges. The shape of the correlation function is also derived and compared with the experimental results of Shiotani. The thermal microscale and the size of the smallest eddies are expressed in terms of the turbulent Reynolds number and Péclet number or the fluid Prandtl number.

532.517.4

3190. REMARKS ON CHANDRASEKHAR'S RESULTS RELATING TO HEISENBERG'S THEORY OF TURBULENCE.
G.Blanch and H.Ferguson.
Phys. of Fluids, Vol. 2, No. 1, 79-84 (Jan.-Feb., 1959).

Improved numerical results are obtained for the spectrum of turbulence based on Heisenberg's elementary theory during the stage of decay in a nonstationary process, which is discussed in Chandrasekhar's 1949 paper. The choice of the form of the differential equation is examined from the viewpoint of its sensitivity in numerical computations to variations of the basic parameter.

532.528 : 534.39

3191. ONSET OF ULTRASONIC CAVITATION IN TAP WATER.
M.Strasberg.
J. Acoust. Soc. Amer., Vol. 31, No. 2, 163-76 (Feb., 1959).

The conditions influencing the onset of acoustically-induced cavitation in tap water were investigated, with special attention to the effect of air-filled cavitation nuclei. Cavitation was induced by exciting an acoustic radial mode in the water in a spherical resonator at a frequency near 25 kc/s. Air-filled nuclei were detected by observing the reverberant decay of sound in the resonator at frequencies from 150 to 550 kc/s, the presence of air nuclei causing an increase in the decay rate. Measurements were made of the sound pressure required for cavitation inception, and of the content of air nuclei, for the following treatments of the water: (1) allowing the water to stand undisturbed after drawing from the tap, (2) partially deaerating the water, and (3) subjecting the water to increased static pressure. Some measurements were also made of the threshold for rectified diffusion into air bubbles. The experimental results are compared with theoretical predictions based on three alternate forms of air nuclei: (1) free air bubbles, (2) air trapped in cracks on suspended solid particles, and (3) air bubbles surrounded by skins of organic impurities.

532.528 : 534.39

CAVITATION MICROSTREAMING. See Abstr. 2182

532.542

3192. SINGLE-PHASE TRANSFER OF LIQUEFIED GASES.
R.B.Jacobs.
Circ. Nat. Bur. Stand., No. 596, 42 pp. (1958).

The problems encountered in the single-phase transfer of liquefied gases are discussed in detail. A general system of equations and the empirical information required for the design of long-distance transfer systems are presented. A closed-form solution of the mathematical equations for incompressible flows is obtained and discussed. Information required for numerical computations involving helium, hydrogen, nitrogen, and oxygen is presented in graphical form. The numerical solution for three general problems involving hydrogen and oxygen are obtained.

532.542.1

3193. A GREEN'S FUNCTION SOLUTION FOR THE CASE OF LAMINAR INCOMPRESSIBLE FLOW BETWEEN NON-CONCENTRIC CIRCULAR CYLINDERS.
J.F.Heyda.
J. Franklin Inst., Vol. 267, No. 1, 25-34 (Jan., 1959).

Determination of Green's function in bi-polar coordinates for the potential equation for a non-concentric annular region. This is used to solve Poisson's equation for the point velocity in laminar incompressible flow between non-concentric circular cylinders.

532.57

3194. A VARIABLE AREA FLOWMETER USING RADIOACTIVE ISOTOPE TECHNIQUES.
P.T.Blacker and D.M.Harris.
Atomic Energy Res. Establ. (Harwell) Mem. R/M159, 2 pp. (1958).

A flowmeter is described in which a collimated beam of γ-rays is interrupted by a tapered float. The degree of absorption of the γ-ray beam by the float is used as a measure of flow rate. Calibration curves (for water at 15°C, over the flow range 0.5-5.5 litres/min) and a discussion on possible development are included.

532.570.8 : 578.087.77

3195. REGISTRATION OF PHASIC CHANGES OF BLOOD FLOW BY MEANS OF A CATHETER-TYPE FLOWMETER.
H.P.Pieper.
Rev. sci. Instrum., Vol. 29, No. 11, 965-7 (Nov., 1958).

A differential transformer with variable coupling placed at the tip of a catheter tube and surrounded by an umbrella type device has been used for the measurement of blood velocity. The instrument was carefully tested by means of a pump producing truly sinusoidal fluid movement. It was shown that the flowmeter has a linear characteristic and a linear frequency response with pump frequencies up to 25 c/s. A blood flow recording taken in the ascending aorta of a dog with unopened chest demonstrates the instrument's practical application.

532.612.4

3196. ON THE STATISTICAL THEORY OF THE SURFACE TENSION OF BINARY MIXTURES.
A.Englert-Chwoles and I.Prigogine.
Nuovo Cimento Suppl., Vol. 9, No. 1, 347-55 (1958).

This is a calculation of the surface tension of binary solutions which makes use of the "average potential" model of Prigogine and his collaborators. The thermodynamic properties of both the liquid phase and the surface phase are expanded to the second order in the parameters

$$\theta \equiv (\epsilon^*_{AB} - \tfrac{1}{2}\epsilon^*_{AA} - \tfrac{1}{2}\epsilon^*_{BB})/\epsilon^*_{AA},$$

$$\delta \equiv \epsilon^*_{BB}/\epsilon^*_{AA} - 1 \qquad \text{and}$$

$$\rho \equiv r^*_{BB}/r^*_{AA} - 1.$$

It is assumed that

$$r^*_{AB} = \tfrac{1}{2}(r^*_{AA} + r^*_{BB}),$$

that the surface phase is monomolecular and that the use of mean interactions is justifiable, even in the surface phase. The calculated excess surface tension (which is negative) is compared with experimental values for the 4 systems: cyclohexane–CCl_4 and neopentane with CCl_4, cyclohexane and benzene. The results show good agreement between theory and experiment. Some consideration is also given to solutions of light isotopes and it is concluded that quantum effects will lower the surface tension. R.O.Davies

MOLECULAR THEORY OF LIQUIDS

532.7

3197. STRUCTURE OF UNIFORM LIQUIDS. G.H.A.Cole.
Amer. J. Phys., Vol. 27, No. 3, 136-46 (March, 1959).

Calculations of the properties of classical liquids are, at the present time, based upon a detailed and accurate knowledge of the distribution of pairs of molecules within the liquid. In the present paper the reasons for this are explained, and the methods so far proposed for obtaining the necessary information for equilibrium conditions are explored.

532.7

3198. STRUCTURAL DYNAMICS OF WATER BY NEUTRON SPECTROMETRY.
B.N.Brockhouse.
Nuovo Cimento Suppl., Vol. 9, No. 1, 45-71 (1958).

An extensive series of measurements on H_2O and D_2O is presented. Experimental methods are discussed and the results analysed by comparison with calculations for crystals and gases, and by the method of Van Hove (Abstr. 8679/1954), in which correlation functions and scattering are related. The results are generally consistent with an ice-like structure, the molecules vibrating with frequencies high compared to their translational motion. The self-correlation function can be described as non-Gaussian, with an r.m.s. radius ~ 1 A, which expands with a variety of diffusive motions occurring simultaneously with reorientation at a time of breakdown of local structure.

P.Gray

532.7

3199. ATOM MOVEMENTS IN SIMPLE LIQUIDS BY TRACER TECHNIQUE.
G.Careri.
Nuovo Cimento Suppl., Vol. 9, No. 1, 72-6 (1958).

Brief reports are given of work on In–Pb solutions and He^3–He^4 mixtures. In the first case solid rods of the metals were placed in contact inside capillary tubes, and then maintained for a predetermined time at some temperature above the melting points. The value of the diffusion coefficient obtained depended on the tube size for small tubes; evidence of a skin effect which could be explained by the formation of microvortices. In the second, the diffusion coefficient of He^3 was measured with some difficulty, and ionic mobilities were obtained on the assumption that the drift velocity was equal to the normal fluid velocity. P.Gray

532.7 : 532.613.5

3200. EQUATION OF STATE AND SURFACE TENSION OF LIQUIDS.
S.Ono.
Nuovo Cimento Suppl., Vol. 9, No. 1, 166-79 (1958).

A cell theory of liquids is presented which unifies the Lennard-Jones and Devonshire theory (LJD) and the hole theory. The parameters in the theory are fitted by requiring that the theory go over to the correct ideal gas formulae at low densities and to the LJD theory at high densities. In addition, the cell size is adjusted to minimize the free energy. The predicted critical parameters are compared with four other approximate theories and with experiment. The results are good. The method is extended to deal with the liquid–gas equilibrium, using an appropriately chosen lattice with one set of principal planes parallel to the interface. The minimization now yields a condition which can be interpreted quasi-thermodynamically as requiring the continuity of a "surface" chemical potential. Numerical calculations yield the distribution of density through the interfacial layer and a calculated value of surface tension for A at 90°K as 9.0 dyne cm^{-1} — the observed value being 11.9 dyne cm^{-1}. R.O.Davies

532.7

3201. THE PROPERTIES OF ISOTOPIC LIQUIDS. A.Bellemans.

Nuovo Cimento Suppl., Vol. 9, No. 1, 181-8 (1958).

If the vapour pressure and volume of a series of isotopic liquids are represented as a function of de Boer's quantum parameter $\Lambda = h/\sigma(m\,\epsilon)^{\frac{1}{2}}$, it is found that heterocompounds (such as HT and HD) behave anomalously. To explain this and other discrepancies a rough estimate is made of quantum contributions to the rotation and rotation—vibration parts of the molecular partition function. There are some indications that the effects involved are of the right order. R.O.Davies

532.7 : 537.226.1

3202. DIELECTRIC SATURATION AND INTERMOLECULAR FORCES IN LIQUIDS. A.Piekara.

Nuovo Cimento Suppl., Vol. 9, No. 1, 192-8 (1958). In French.

The dielectric constant of polar liquids in non-polar solvents may increase in a strong electric field; in some cases both effects are found at different concentrations. This paper reviews the knowledge of this effect and explains the author's theory, which connects the facts with intermolecular forces other than the dipole—dipole interactions. These forces may tend to line up pairs of molecules with their dipoles antiparallel to one another. This reduces the effective dipole moment per molecule — the reduction being broken down by the external field. R.O.Davies

532.7 : 530.162

3203. STATISTICAL-MECHANICAL THEORY OF TRANSPORT IN FLUIDS. H.Mori.

Phys. Rev., Vol. 112, No. 6, 1829-42 (Dec. 15, 1958).

A theory of transport processes in fluids of g components is presented on the assumption that the macroscopic state of the system can be described by one velocity, one temperature, and g mass-density fields. The formulation is based on the explicit recognition of the fact that there are two relaxation processes in fluids: one is the macroscopic process of attaining spatial uniformity and is represented by the hydrodynamical equations, whereas the other is the microscopic process of attaining internal thermal equilibrium in small elements of macroscopic size and determines the transport coefficients. For instance, in dilute gases the microscopic process is the relaxation process in momentum space. The coupling of the two processes is investigated to obtain the dissipative terms in the transport equations with the aid of the correlation function method outlined in a previous paper. The hydrodynamical equations, the equation of entropy balance, and the linear relations between the thermodynamic fluxes and affinities are thus derived with explicit expressions for the coefficients of viscosity, thermal conductivity, and diffusion, which are valid for liquids as well as for gases. The classical limits of these expressions, $h \to 0$, are somewhat different from those obtained by Green for classical mechanical systems.

532.7

3204. DETERMINATION OF FLUID MOLECULAR ORDER. G.H.A.Cole.

Proc. Phys. Soc., Vol. 72, Pt 5, 887-9 (Nov., 1958).

A method is proposed for finding the pair distribution function $n^{(2)}$ in simple classical fluids, starting from a reasonably good approximate function — perhaps obtained from X-ray data. The method linearizes the multiple integral for the exact function in terms of the unknown correction to the effective potential. The resultant expression can then be evaluated provided that the superposition approximation is used for $n^{(3)}$ and $n^{(4)}$. R.O.Davies

532.7

3205. THE ATOMIC DISTRIBUTION IN LIQUID ANTIMONY. H.K.F.Müller and H.Hendus.

Z. Naturforsch., Vol. 12a, No. 2, 102-11 (1957). In German.

This was studied by X-ray diffraction methods, and was found to be significantly different to that in both the crystalline and amorphous states. The experimental arrangements for the X-ray study of the molten sample at 665°C are described in detail, as are the intensity curves and their analysis. It seems that there is a change from rhombohedral to simple cubic structure in melting, corresponding to a loosening of the homopolar binding. J.Hawgood

532.7 : 530.162

THE TRANSPORT PROPERTIES OF DENSE ASSEMBLIES OF RIGID SPHERES. See Abstr. 3161

532.72

3206. FURTHER EXPERIMENTS ON LIQUID INDIUM AND TIN SELF-DIFFUSION. G.Careri, A.Paoletti and M.Vicentini.

Nuovo Cimento, Vol. 10, No. 6, 1088-99 (Dec. 16, 1958).

Further to experiments on the self-diffusion coefficient, D, give evidence of an effect of the diameter size of the capillaries used. This effect is important for indium and is almost negligible for tin. The values of D measured in the capillaries of the largest size (1.60 mm dia.) are taken to be the correct values for the self-diffusion coefficient. This is because using capillaries with diameter > 1.6 mm the values of D were constant in the experimental error. The dependence of D from the absolute temperature is of Arrhenius type: for indium:

$$D = (33.4 \pm 2.1)\,10^{-5} \exp\left[\frac{2554 \pm 79}{RT}\right] cm^2/sec,$$

for tin:

$$D = (32.4 \pm 1.2)\,10^{-5} \exp\left[\frac{-2768 \pm 80}{RT}\right] cm^2/sec.$$

532.72 : 538.69 : 538.27

3207. DIFFUSION AND NUCLEAR SPIN RELAXATION IN WATER. J.H.Simpson and H.Y.Carr.

Phys. Rev., Vol. 111, No. 5, 1201-2 (Sept. 1, 1958).

The diffusion coefficient and the spin lattice relaxation time of protons in ordinary water have been measured in the temperature range 0-100°C using nuclear magnetic resonance free precession techniques. Unlike previous diffusion measurements, the present values describe the diffusion of protons rather than foreign isotopes introduced as tracers. To within the experimental error the Stokes—Einstein relation adequately describes the relative temperature dependence of viscosity and diffusion, but above the vicinity of 40°C the spin lattice relaxation does not follow the viscosity in the predicted manner.

532.72

3208. SELF-DIFFUSION IN LIQUID: PARAFFIN HYDROCARBONS. D.W.McCall, D.C.Douglass and E.W.Anderson.

Phys. of Fluids, Vol. 2, No. 1, 87-91 (Jan.-Feb., 1959).

The pressure dependence of the self-diffusion coefficients of several normal paraffin hydrocarbons and the isomers of hexane were determined. In addition, the temperature dependence of self-diffusion coefficients were measured for the isomers of hexane. Energies and volumes of activation are calculated. With the exception of 2, 2-dimethyl butane, these parameters do not change significantly with branching in the isomers of hexane. The volumes of activation are about 10-20% of the molar volumes in all cases. Diffusion coefficients computed from a semiempirical modification of an equation derived by Longuet—Higgins and Pople are compared with the experimental results.

532.73

3209. THEORY OF SOLUTIONS. II. OSMOTIC PRESSURE VIRIAL EXPANSION AND LIGHT SCATTERING IN TWO COMPONENT SOLUTIONS. T.L.Hill.

J. chem. Phys., Vol. 30, No. 1, 93-7 (Jan., 1959).

The method of the first paper (J. Amer. Chem. Soc., Vol. 79, No. 18, 4885, Sept. 20, 1957) of this series can be used to provide a rigorous but relatively simple derivation of the McMillan—Mayer osmotic pressure virial expansion and alternative expressions for the virial coefficients B_n. Exact relations are derived relating the B_n to the constant pressure coefficients C_n of Pt I. The initial slope in the usual plot (Hc/τ against c) of light scattering data obtained at constant p is shown to be $2B_2 - 3\bar{v}_2{}^0 + b_{11}$ + refractive index terms (where b_{11} is a cluster integral for solvent-solute interaction) and not $2B_2$, as usually assumed. For hard spheres, this correction is very significant but it is not important if, as is usually the case, the effective solute size for intersolute interactions is large compared with the volume actually occupied by a solute molecule.

532.74

3210. A GEOMETRICAL APPROACH TO THE STRUCTURE OF LIQUIDS. J.D.Bernal.

Nature (London), Vol. 183, 141-7 (Jan. 17, 1959).

Homogeneous, coherent and essentially irregular assemblages of molecules, containing no crystalline regions or holes large enough to admit another molecule, are discussed with the aid of several experimental models, in the absence of any adequate mathematical technique (statistical geometry). The predominance of pentagonal faces on the polyhedra formed by packing balls of plasticine together irregularly and pressing them into one solid lump suggests an essential connection between irregular dense packing and pentagonal surface coordination. An abrupt transition between regular (crystalline) and irregular (liquid) packing, and the high entropy and the fluidity of an irregularly close-packed assemblage, are among the properties explained qualitatively on the resulting theory.

J.G.Oldroyd

532.74

3211. NUCLEAR MAGNETIC RESONANCE AND MOLECULAR ASSOCIATION IN LIQUIDS. L.Giulotto.
Nuovo Cimento Suppl., Vol. 9, No. 1, 101-3 (1958).

Reports measurements of spin—lattice relaxation time (T_1) in solutions of chlorobenzene and of phenol in carbon tetrachloride at room temperature and in pure water from −12°C to +95°C. A plot of $\eta_0/(\eta T_1)$, where η_0 is the viscosity of the solvent and η that of the solution, versus concentration is linear for chlorobenzene and non-linear for phenol, and this is interpreted in terms of molecular association. For water $T_1\eta/T$, where T is the absolute temperature, falls with increasing temperature and this also is interpreted in terms of molecular association.

J.G.Powles

532.77 : 532.133

3212. STUDY OF THE CONFIGURATION OF HIGH POLYMERS IN SOLUTION: A NEW METHOD FOR THE DETERMINATION OF AN IDEAL SOLVENT. U.Bianchi, V.Magnasco and C.Rossi.
Ricerca sci., Vol. 28, No. 7. 1412-18 (July, 1958). In Italian.

A solution of a high polymer can be made ideal at any given temperature by adding a certain proportion of a "non-solvent", the proportion being determined by measurements of the intrinsic viscosity only. For example, a mixture of benzene with 26% methanol is an ideal solvent for polystyrene at 34°C.

J.Hawgood

532.77 : 536.7

THE THERMODYNAMIC PROPERTIES OF THE SYSTEMS: HNO_3—H_2O AND HNO_3—N_2O_4. See Abstr. 1392

532.78

3213. THERMODYNAMIC DRIVING FORCE IN NUCLEATION AND GROWTH PROCESSES. J.D.Hoffman.
J. chem. Phys., Vol. 29, No. 5, 1192-3 (Nov., 1958).

The usual relation assumed between the free energy difference Δf and the enthalpy difference Δh, between the supercooled liquid and the crystalline phase, is $\Delta f = \Delta h_f(T_m-T)/T_m$, where T_m is the melting temperature and Δh_f is the value at T_m. This assumes that Δh is independent of temperature, but it is more realistic, for a substance possessing a glass transition from the supercooled liquid, to take Δh as a linear function of T, which causes the expression for the "driving force" to become $\Delta f = \Delta h_f T(T_m-T)/T_m^2$, which agrees better with experiment.

J.Hawgood

532.783

3214. PROTON RESONANCE OBSERVATION OF MECHANICAL DESTRUCTION OF MAGNETIC ORDERING IN LIQUID CRYSTALS. J.H.Muller and R.D.Spence.
J. chem. Phys., Vol. 29, No. 5, 1195-6 (Nov., 1958).

The structure of the proton resonance lines in P-azoxyphenetole and P-azoxyanisole, due to dipolar interactions in liquids which are ordered by diamagnetic interactions, is destroyed by bubbling helium gas through the liquid, thus removing the ordering mechanically.

J.M.Baker

MECHANICS OF GASES

VACUUM TECHNIQUE

533.15

3215. THEORETICAL CALCULATIONS AND EXPERIMENTAL VERIFICATION FOR A DEMONSTRATION THERMAL DIFFUSION COLUMN. C.E.Español and C.R.Carjuzaa.
Amer. J. Phys., Vol. 27, No. 2, 87-9 (Feb., 1959).

The present paper exemplifies the theoretical calculations for a thermal diffusion column of the hot filament type, easy to build in college laboratories. The separation of a binary mixture of carbon dioxide and argon has been studied and the separation factor, theoretically calculated, has been checked against the experimental separation factor. The results show an acceptable agreement.

533.15

3216. EVIDENCE FOR PERMEABILITY MINIMA IN LOW-PRESSURE GAS FLOW THROUGH POROUS MEDIA. D.M.Grove and M.G.Ford.
Nature (London), Vol. 182, 999-1000 (Oct. 11, 1958).

Permeability is plotted as a function of pressure, following observations on an inert gas flowing through a porous solid at pressures so low that the mean free path greatly exceeds the mean pore diameter. In the case of some ceramics and graphites the permeability goes through a minimum, although for others it flattens off to a constant value below a certain pressure. The results suggest that pore size distribution may determine whether or not a minimum is observed.

J.G.Oldroyd

533.15 : 539.18

THERMAL DIFFUSION FACTORS FROM COLUMN OPERATION. See Abstr. 2863

533.15 : 539.217

DIFFUSION OF HYDROGEN IN PALLADIUM. See Abstr. 2949

533.5

3217. PROGRESS IN VACUUM TECHNOLOGY. J.Pollard.
Rep. Progr. Phys., Vol. 22, 33-71 (1959).

In dealing with mechanical pumps some of the more recent improvements in rotary backing pumps are described, and the advent of the positive displacement rotary compressor is noted and its advantages discussed. The controversial subject of condensation pump theory receives brief attention, and sections on both oil and mercury condensation pumps give the more salient points of the advances leading to the present capabilities of these pumps. Ejector type vapour pumps have been in use for a long period but the use of ejector principles at lower pressures is mentioned as a more recent development. Trap design has kept reasonably in step with progress in vapour pumps, but unsolved physical problems bearing on the efficiency of traps are shown to remain. New methods of pumping are challenging the established position of the vapour pump, and the achievements of various types of ionization and gettering type pumps are reviewed, as is some of the work on the mechanism of pumping in devices of this nature. Comparison of pumping speeds quoted by different workers has been difficult, due not only to differing definitions but to large errors inherent in many methods of speed measurement. Progress in understanding and resolving this problem is described. In a section on pressure measurement progress in various types of gauges is assessed. Recently long-standing obstacles to measuring very low pressures have been overcome; the methods which have been developed, including some still in the laboratory stage, are discussed. The whole new subject of very low pressure techniques is one in which there has been rapid advance; this is surveyed and future trends are suggested. The growth of leak detection as a branch of vacuum technology is discussed and a brief review of some methods is given.

533.59

3218. ON THE EVACUATION SPEED OF A VACUUM SYSTEM. T.Kraus.
Naturwissenschaften, Vol. 45, No. 22, 538 (1958). In German.

An expression is obtained relating the residual gas pressure to the time in terms of the volume of the system, the final pressure, the speed of the pump, and of an equivalent pressure which takes into account desorption from the walls.

J.Dutton

MOLECULAR THEORY OF GASES

533.7

3219. ON THE PARTITION FUNCTION OF A ONE-DIMENSIONAL GAS. M.Kac.
Phys. of Fluids, Vol. 2, No. 1, 8-12 (Jan.-Feb., 1959).

A method is presented for calculating the grand-partition function of a one-dimensional gas with the potential $V(x) = +\infty$ for $0 \leq x < \delta$ and $V(x) = -\alpha\, e^{-\gamma x}$ for $x \geq \delta$.

533.75 : 536.71

3220. APPARATUS FOR THE DETERMINATION OF THE EQUATIONS OF STATE OF COMPRESSED GASES AT HIGH TEMPERATURES. APPLICATION TO THE STUDY OF NITROGEN UP TO 1000 kg/cm² AND 1000°C. J.Saurel.
J. Rech. Cent. Nat. Rech. Sci., No. 42, 21-60 (March, 1958).
In French.

The method consists of the measurement of the temperature and pressure P of a gas occupying a given volume V. Complete details are given of the apparatus. Internal heating is used. Data for the measurements on nitrogen are presented graphically in the form of isothermal diagrams of (PV) as a function of P and as a function of density ρ. Values are derived for the coefficients in the relations

$$PV = RT + BP + CpP^2 + DpP^3$$

$$PV/RT = 1 + B\rho + C_\rho\rho^2 + D_\rho\rho^3 + E_\rho\rho^4$$

S.Weintroub

VIBRATIONS . ACOUSTICS

534.133 : 539.21

3221. FREQUENCY ALTERATION OF A THICK X-CUT QUARTZ CRYSTAL, PRODUCED BY NEUTRON BOMBARDMENT. K.Zuber.
Rev. Fac. Sci. Univ. Istanbul C, Vol. 23, No. 1, 42-9 (Jan., 1958).
In German.

The characteristic frequencies have been measured before and after bombardment and a variation in the elastic moduli has been found. Values of the change in elastic moduli are calculated theoretically. J.M.Hough

534.2

3222. THE PROPAGATION OF ELASTIC WAVES IN CRYSTALS AND OTHER ANISOTROPIC MEDIA. M.J.P.Musgrave.
Rep. Progr. Phys., Vol. 22, 74-96 (1959).

The general principles governing the behaviour of plane elastic waves in aeolotropic media are developed and the significance of the velocity, slowness and wave surfaces is indicated. Sections of these surfaces for media of hexagonal and cubic symmetry are illustrated and discussed from a theoretical and an experimental standpoint. The general problem of reflection and refraction which arises when a plane wave is incident upon a plane interface between two arbitrarily oriented aeologropic media is discussed and exemplified by a simple case involving two copper crystals. The conditions under which surface waves of Rayleigh and Love types may be propagated are discussed. Problems of elastic wave propagation in anisotripic aggregates are mentioned and briefly examined.

534.213 : 535.42

3223. DIFFRACTION OF LIGHT BY ULTRASONIC WAVES PROGRESSING WITH FINITE BUT MODERATE AMPLITUDES IN LIQUIDS. K.L.Zankel and E.A.Hiedemann.
J. Acoust. Soc. Amer., Vol. 31, No. 1, 44-54 (Jan., 1959).

The study of the asymmetry of the light diffracted by ultrasonic waves progressing with moderate amplitudes in liquids is used to detect and measure the finite amplitude distortion in water and carbon tetrachloride. A theory is developed which relates the distortion present to available isothermal compressibility measurements. This development includes the presence of absorption. Measurements of the second harmonic were made in water at 2 Mc/s and 4 Mc/s, at distances up to 50 cm, and at peak ultrasonic pressures between zero and 1.5 atm. More detailed measurements were made in carbon tetrachloride at frequencies of 2 and 3 Mc/s, at distances up to 21 cm, and at pressures up to 0.7 atm. For both liquids, good agreement is obtained between the experimentally measured values and the theoretically predicted results. Small amounts of distortion were easily measured. The second harmonic could be measured when the intensity of the harmonic is less than 0.04% of the intensity of the fundamental. Distortion could be measured when the fundamental was much less than 0.2 atm.

534.22 : 532.7

3224. PROPAGATION OF SOUND IN LIQUID METALS: THE VELOCITY IN LEAD AND TIN. R.B.Gordon.
Acta metallurgica, Vol. 7, No. 1, 1-7 (Jan., 1959).

The velocity of propagation of longitudinal waves was measured over a temperature interval upward from the freezing point. A constant linear decrease of the sonic velocity with increasing temperature is found in both metals. The acoustic data are used to evaluate the parameters in a simple hole theory of the liquid state, which are then compared with data for diffusion in liquid metals.

534.22

3225. TEMPERATURE DEPENDENCE OF SOUND DISPERSION IN HALO-METHANE GASES. R.Amme and S.Legvold.
J. chem. Phys., Vol. 30, No. 1, 163-7 (Jan., 1959).

Sound dispersion was examined in eight halo-methane gases near 100°C and 200°C, and four near 300°C. The observed relaxation times are used along with data obtained previously at room temperature to calculate the vibrational collision lifetimes over this temperature range. The results are compared with theoretical predictions of Schwartz and Herzfeld which used an attractive term in the potential to help account for the effect of long-range forces. Agreement is good, although several lifetimes at room temperature appear somewhat small.

534.22

3226. INVESTIGATION OF THE MECHANISM OF ULTRASONIC PROPAGATION IN NITROGEN UNDER HIGH PRESSURE.
E.Hayess.
Z. phys. Chem. (Leipzig), Vol. 206, No. 3-4, 210-20 (Feb., 1957).
In German.

Measurements of the velocity and of the absorption coefficient, at frequencies between 800 and 10 000 c/s, were made in nitrogen under pressure. The dependence of γ, the ratio of the specific heats, and of the molecular heat at constant volume, on pressure were measured and the results are shown in the form of graphs. The subject is theoretically discussed on the basis of thermal relaxation, and the advantages of the use of ultrasonics in glass are discussed. T.C.Toye

534.22

3227. ULTRASONIC VELOCITY IN ORGANIC SOLUTIONS.
K.C.Lal and P.N.Sharma.
Z. phys. Chem. (Leipzig), Vol. 206, No. 3-4, 231-7 (Feb., 1957).

Rao's equation for ultrasonic velocity in organic liquids

$$V^{\frac{1}{3}} M/d = R$$

(V = ultrasonic velocity, M = molecular weight, d = density, R is a constant) also applies directly to liquid mixtures thus:

$$V_{12}^{\frac{1}{3}} M_{12}/d_{12} = R_{12},$$

where

$$R_{12} = R_1x + (1-x)R_2$$

$$M_{12} = M_1x + (1-x)M_2$$

(x = molecular fraction of solute and the suffixes 1, 2 and 12 refer to solute, solvent and mixture respectively). In this paper experiments using the light diffraction method are briefly described and a large number of results are given which clearly show that the above formulae also apply to solution of solids in organic liquids.

T.C.Toye

534.222.2

3228. COMPARATIVE STUDY OF THE CHARACTERISTICS OF EXPLOSION WAVES IN GASEOUS MIXTURES.
J.Brossard and N.Manson.
C.R. Acad. Sci. (Paris), Vol. 247, No. 23, 2105-8 (Dec. 10, 1958).
In French.

Detonation velocities of oxyhydrogen and oxyacetylene explosions at various pressures and mixture strengths are calculated from thermodynamic data and are compared with published results and semi-empirical relations. A.G.Gaydon

534.222.2

3229. THE SAHA EQUATION AND THE ADIABATIC EXPONENT IN SHOCK WAVE CALCULATIONS. R.A.Alpher.
J. Fluid Mech., Vol. 2, 123-6 (1957).

A short review is given of methods for calculating shock transitions where ionization phenomena occur. Possible errors are pointed out and references are given which should be helpful in performing such calculations. Mathematical Reviews

534.23

3230. SOME ASPECTS OF ULTRASONIC ATTENUATION IN COMMON METALS. S.Tanaka.
Rep. Inst. High Speed Mech., Tohoku Univ., No. 90, 149-58 (1958). (1958).

The absorption of longitudinal ultrasonic waves, in the frequency range 0.5 to 6.0 Mc/s, was studied in a number of metals and alloys by a pulse technique. The results have been compared, both by theory and by experiment, with the Q value of a specimen of the metal of standard shape; the specimen was driven into resonance by an X-cut quartz plate operated below its natural frequency. Order of magnitude agreement is found and it is suggested that relative Q values may be useful. L.Mackinnon

534.23

3231. MAGNETIC FIELD DEPENDENCE OF ULTRASONIC ATTENUATION. M.J.Harrison.
Phys. Rev. Letters, Vol. 1, No. 12, 442-3 (Dec. 15, 1958).

An expression is derived for the magnetic field variation of electronic ultrasonic absorption in metals at low temperatures.

This expression shows both oscillatory effects and an ultimate high or low attenuation at large fields, and is shown to have some correspondence with experimental data. Certain apparently ad hoc assumptions are however made in the derivation, which is a calculation of the work done by a sound-wave force-field on an electron which is orbiting in the magnetic field. L.Mackinnon

534.23

3232. ABSORPTION OF FINITE-AMPLITUDE ULTRASONIC WAVES. R.T.Baier and V.Narasiman.
Akust. Zh., Vol. 4, No. 2, 196-7 (1958). In Russian.

Work on the topic over the last three years is surveyed and the critical experimental data required at this stage for verifying the absorption laws are indicated. C.R.S.Manders

534.23

3233. ULTRASONIC ABSORPTION IN SOME HOMOLOGOUS SERIES OF ORGANIC LIQUIDS.
S.Parthasarathy, M.Pancholy and A.F.Chhapgar.
Nuovo Cimento, Vol. 10, No. 6, 1053-9 (Dec. 16, 1958).

For previous work see Abstr. 2170 (1959). Values of ultrasonic velocity and absorption coefficient in a number of alcohols are reported. The relationship between molecular weight on the one hand and absorption coefficient and velocity together with their temperature coefficients on the other, is discussed. It is suggested that the excess absorption in alcohols is mainly due to bulk viscosity. Some general conclusions regarding absorption in homologous series are also given.

534.26

3234. GEOMETRICAL THEORY OF DIFFRACTION IN INHOMOGENEOUS MEDIA. B.D.Seckler and J.B.Keller.
J. Acoust. Soc. Amer., Vol. 31, No. 2, 192-205 (Feb., 1959).

The geometrical theory of diffraction is described. It is used to determine the diffracted fields in inhomogeneous media. Cases in which such media contain smooth convex bodies are treated. The theory employs an extension of Fermat's principle which yields diffracted rays. By energy considerations the field associated with each ray is calculated. This calculation requires the introduction of diffraction coefficients and decay exponents. General formulae for these quantities are given in terms of local properties of the medium and of the body. (See also following abstract).

534.26

3235. ASYMPTOTIC THEORY OF DIFFRACTION IN INHOMOGENEOUS MEDIA. B.D.Seckler and J.B.Keller.
J. Acoust. Soc. Amer., Vol. 31, No. 2, 206-16 (Feb., 1959).

Some boundary value problems are considered for the reduced wave-equation in media having planar or cylindrical stratification. They are solved exactly and the solutions are expanded asymptotically for high frequencies by using the method of stationary phase in conjunction with the W.K.B. method and the Watson transformation. The asymptotic expansions are compared with the corresponding diffracted fields found by using the geometrical theory described in the preceding abstract. In all cases, the asymptotic expansions agree completely with the corresponding results derived by the geometrical theory, thus verifying this theory.

534.26 : 538.566.2

SCATTERING OF PLANE ACOUSTIC WAVES BY LOCAL RANDOM NOISE. See Abstr. 2542

534.321.9 : 535.42

DIFFRACTION OF LIGHT BY A PROGRESSIVE ULTRASONIC WAVE. See Abstr. 2245

534.321.9 : 535.42

STUDY OF THE INTENSITY DISTRIBUTION OF THE LIGHT DIFFRACTED BY ULTRASONIC WAVES. See Abstr. 2246

534.372 : 539.433

3236. ATTENUATION OF SMALL AMPLITUDE STRESS WAVES IN SOLIDS. L.Knopoff and G.J.F.MacDonald.
Rev. mod. Phys., Vol. 30, No. 4, 1178-92 (Oct., 1958).

Earlier theoretical work and laboratory and seismic measurements of attenuation at small strains are reviewed. The specific dissipation function of both longitudinal and torsional vibrations of many solids are frequency independent over a wide range. As the usual linear attenuation theories do not give this frequency dependence a nonlinear permanent deformation model is considered. The model is analysed in detail for wave and pulse propagation. Quite small nonlinear terms in the equation will account for the observed attenuation. Other nonlinear models can also give results consistent with experiment and to explain the actual mechanism of dissipation requires further experimental evidence. H.Mykura

534.39

3237. MEASUREMENT OF THE WIND PRODUCED IN LIQUIDS BY AN EXCITED PIEZOELECTRIC QUARTZ.
A.Carrelli and F.Cennamo.
Nuovo Cimento, Vol. 9, No. 2, 303-8 (July 16, 1958).

The radiation pressure and streaming velocity produced by 5.5 and 6.6 Mc/s quartz transducers in water were measured. The reported ratios of the bulk to shear viscosities do not correlate with those predicted from ultrasonic absorption measurements in water. H.D.Parbrook

534.39 : 532.528

ONSET OF ULTRASONIC CAVITATION IN TAP WATER. See Abstr. 3191

534.61

3238. PARTICLE SUSPENSION TECHNIQUE FOR MEASURING SCATTERED SOUND ENERGY. A.S.Buchman.
J. Acoust. Soc. Amer., Vol. 30, No. 10, 985 (Oct., 1958).

A technique is described for supporting a small particle in a sonic-free field within 1 mm of a desired location by suspension in a gel. H.D.Parbrook

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also the Section entitled "BIOPHYSICS. PHYSIOLOGICAL PHYSICS".

534.832

3239. THEORY OF NOISE AND VIBRATION INSULATION OF A SYSTEM WITH MANY RESONANCES. E.Skudrzyk.
J. Acoust. Soc. Amer., Vol. 31, No. 1, 68-74 (Jan., 1959).

The results obtained in a previous paper (Abstr. 2154-5/1959) of this study, are summarized and used to derive the theory of vibration and sound insulation of systems with many natural frequencies, such as machines with more than one resonance mounted on resonating springs, a motor spring-mounted on a shell, or plates at higher frequencies. At lower frequencies, the quality of the insulation is a function of the ratio of the square of the lowest fully excited resonant frequency to that of the frequency of the force. Weakly excited natural modes cause spikes in the transmission curve. Resonances in the vibrating masses may annihilate completely the effect of the vibrator mounting, whereas resonances in the springs are harmless as long as the mass is small in comparison to that of the machinery. Spring mounting a vibrator on a shell or plate reduces the noise level considerably. Any measure that increases the fundamental natural frequency to the housing helps to improve vibration insulation. Mounting the vibrator in a rigid cage or onto a rigid girder seems to be expedient; and welding these along a whole circumference or along their whole length onto the housing, to simulate a one-dimensional vibration pattern, is expedient. The noise radiation of a shell or plate to greater distances can be reduced by increasing the mass of the radiating shell or plate and by decreasing its size sufficiently to reduce the number of modes that radiate sound. Damping diminishes the sound radiation at lower frequencies, but has very little effect on it at higher frequencies.

534.845 : 621.396.97

3240. [HELMHOLTZ-TYPE] SLIT RESONATORS AS LOW FREQUENCY SOUND ABSORBERS. D.Govinda Ragavan.
J. Instn Telecomm. Engrs (New Delhi), Vol. 4, No. 4, 213-19 (Sept., 1958).

The theorectial values of resonant frequency, bandwidth and maximum absorption tally fairly well with the values obtained in the test chambers and in studios. Such low frequency resonators are in use at present in some of the All India Radio studios.

OPTICS . SPECTRA . LUMINESCENCE

535.23 : 536.5.081

3241. RADIATION CONSTANTS, THE RADIATION EQUIVALENT OF LIGHT AND THE OPTICAL SCALE OF TEMPERATURE.
H.Moser, U.Stille and C.Tingwaldt.
Optik, Vol. 14, No. 7-8, 291-302 (July-Aug., 1957). In German.

Discusses the effect of fresh determinations of the gold-point and the atomic constants on the values of the radiation constants c_1, c_2 and the Stefan—Boltzmann constant. The best numerical values seem to be 5.9544 (c^2h), 1.4388 and 5.6688, giving a value of 669 lm/W for the radiation equivalent of light. J.W.T.Walsh

535.23.08 : 551.508.2

3242. CONVECTION FREE INSTRUMENT FOR MEASURING INFRARED RADIATION IN THE ATMOSPHERE. R.L.Aagard.
Rev. sci. Instrum., Vol. 29, No. 11, 1011-16 (Nov., 1958).

A null type radiometer measures the equivalent black-body radiation temperature in the atmosphere at night by supplying electrical power to the absorber surface to replace the net loss of energy by radiation and keep the surface at the ambient air temperature. Thus convection effects are eliminated. A thermopile is used to detect the absorber-surface temperature difference from air and provide a signal to the high gain transistor d.c. amplifier of the servo system. Apparatus is also described which was used to verify the instrument's theoretical calibration.

535.231.5

3243. THE REALIZATION OF A BLACKBODY AT THE GOLD- AND AT THE SILVER-POINT FOR PYROMETRIC TEMPERATURE MEASUREMENTS. C.Tingwaldt and H.Kunz.
Optik, Vol. 15, No. 6, 333-42 (June, 1958). In German.

A new form of blackbody is described suitable for measurements above the gold-point, t_{Au}, and one of similar construction but of different material for optical measurements near the silver-point, t_{Ag}. They can be viewed directly without the usual interposition of lenses or prisms, and can be easily adjusted. Results of tests are given. The value of ($t_{Au} - t_{Ag}$) was determined to within 0.25°C and found to be between 102.1 and 102.5°C depending upon the accepted value chosen for t_{Au}. (c_2 was taken to be 1.438 cm. deg.C.) S.Weintroub

535.241

3244. DETERMINATION OF THE FRACTION OF RADIATION INCIDENT ON A CIRCULAR DIAPHRAGM FROM A SURFACE SOURCE EMITTING ACCORDING TO THE COSINE LAW.
M.M.Agrest.
Zh. tekh. Fiz., Vol. 28, No. 6, 1340-4 (1958). In Russian.

Simple formulae are derived for the fraction of radiation emitted by a source uniformly distributed over a disc, or the surface of a hollow cylinder, and intercepted by a circular diaphragm. The source emits according to the law $I = I_0\cos\theta$ where θ is the angle to the normal. S.Chomet

535.241 : 513.43

3245. DETERMINATION OF THE SOLID ANGLE FORMED BY A CIRCULAR TARGET RELATIVE TO A POINT SOURCE.
M.M.Agrest, M.Z.Maksimov and A.N.Khmelevskiĭ.
Zh. tekh. Fiz., Vol. 28, No. 6, 1345-8 (1958). In Russian.

A finite and exact expression for the above angle is derived. S.Chomet

535.241.14

3246. TRANSMISSION OF THREE INCOMPLETE POLARIZERS IN SERIES. H.Alexander and V.Semjonow.
Optik, Vol. 14, No. 6, 256-9 (June, 1957). In German.

A correction to a formula of Mielenz (Abstr. 175/1956). W.T.Welford

535.242.6

3247. HETEROCHROMATIC PHOTOMETRY BY MEANS OF COLORIMETRIC COMPENSATION. H.D.Einhorn.
J. Opt. Soc. Amer., Vol. 49, No. 3, 263-7 (March, 1959).

A method of heterochromatic photometry is described whereby the difference in colour is eliminated by the admixture of saturated blue and red lights. Test results indicating observer variations are reported. The merits, problems, and potentialities of the method are discussed.

535.244

3248. SUITABILITY OF POLARIZATION FILTERS FOR PHOTOMETRIC MEASUREMENT. K.D.Mielenz and R.C.Jones.
Optik, Vol. 15, No. 11, 656-69 (Nov., 1958). In German and English.

An analysis of the transmission of light through a series of polarizers in succession leads to a discussion of the accuracies of different photometers of this type. The birefringence of polarizers of the dichroic molecular type (such as Polaroid) is discussed in one section of the paper which is in English. J.W.T.Walsh

535.245

3249. MEASUREMENTS OF LIGHT INTENSITIES OF REAL IMAGES OF LIGHT SOURCES. O.Reeb and H.J.Hentschel.
Optik, Vol. 15, No. 7, 422-8 (July, 1958). In German.

A discussion of measurements by photocell or similar means of the distribution of light intensity across an image; the results may be invalidated on either of two grounds: (a) the cell may be too near the lens to receive all the luminous flux, or (b) the cell may be too near for the photometric laws to hold good. For valid results the distance from lens to receiver must satisfy two conditions as to minimum distance and these distances are calculated for various cases, on various assumptions of the relationship between flux and angle of emission from source. The special cases of a volume radiator and of a source obeying Lambert's law are included. N.Corcoran

535.245 : 522.61

VISUAL PHOTOMETER FOR STUDYING THE EARTH-LIGHT ON THE MOON. See Abstr. 3033

535.247

3250. USE OF EMULSION THICKNESS VARIATIONS WITH BLACKENING FOR PHOTOGRAPHIC PHOTOMETRY.
E.Lau, E.G.Kind and G.Roose.
Optik, Vol. 15, No. 2-3, 162-80 (Feb.-March, 1958). In German.

An exposed photographic emulsion, after development and fixing, shows variations of thickness which under certain conditions follow the corresponding variations of density with some fidelity. The authors describe the various effects which have to be eliminated or allowed for when the phenomenon is used to replace densitometry in photographic photometry. J.W.T.Walsh

535.247.1 : 551.521.63

3251. AN AUTOMATIC INSTRUMENT RECORDING DAYTIME ULTRAVIOLET. A.H.Allan.
New Zealand J. Sci. Technol. B, Vol. 38, No. 8, 820-5 (Sept., 1957).

A photocell in a rugged housing integrates the ultraviolet energy in daylight and records it every quarter of an hour on a printometer. The instrument uses mains power and has no batteries. One electronic tube needs to be replaced about every three months when in continuous operation, but apart from this no skilled attention is needed. Observations at three widely separated New Zealand sites are reported.

535.247.4 : 535.411

3252. DESIGN OF A RECORDING MICROPHOTOMETER. STABILIZATION OF THE LIGHT SOURCE EMPLOYED.
N.Ségard and E.Deffontaines.
Ann. Soc. Sci. Bruxelles I, Vol. 72, No. 3, 170-8 (1958). In French.

Describes the use of a photo-multiplier cell for studying interference fringes either directly or when photographed. With a constant voltage on the cell the photocurrent is proportional to the illumination but if the current is maintained constant the reduction of voltage with increase of illumination follows a logarithmic relationship. The authors describe an instrument enabling the cell to be used in either way. They also describe their self-regulating light source (see Abstr. 851/1959). J.W.T.Walsh

535.247.4

3253. ELECTRONIC DETERMINATION OF LINES OF EQUAL DENSITY. I. W.Krug and J.Schusta.
Optik, Vol. 15, No. 2-3, 145-52 (Feb.-March, 1958). In German.

After a general discussion of equidensitometry the authors describe the various methods used for tracing out lines of equal density on a photographic record. Each of the four electronic methods is treated in detail and its advantages and disadvantages are discussed. J.W.T.Walsh

535.247.4

3254. ELECTRONIC DETERMINATION OF LINES OF EQUAL DENSITY. II. W.Krug and J.Schusta.
Optik, Vol. 15, No. 9, 550-9 (Sept., 1958). In German.

Following the discussion in a previous paper (see preceding abstract), two instruments are described, one a photoelectric equidensitometer, in which the lines of equal density on a photographic plate are traced out automatically, the other an "equidensoscope" in which a television-optical arrangement is used to give lines of equal density in a television picture. Possible applications are outlined. J.W.T.Walsh

535.31

3255. IMAGES AND SHADOWS FROM THE VIEWPOINT OF "ENERGY-OPTICS". V.Ronchi.

Bul. Inst. Politeh. Iasi, Vol. 3 (VII), No. 3-4, 65-76 (1957). In Italian.

The author explains how an optical system can be considered in terms of the energy distribution in object and image. The particular case of shadow images is explained in detail, and the importance in photography and radiography stressed. R.W.Fish

535.317

3256. RADIALLY SYMMETRICAL OPTICAL MEDIA. R.Stettler.

Optica Acta, Vol. 3, No. 3, 101-3 (Sept., 1956). In German.

Media are constructed for which light rays satisfy certain boundary conditions on the unit circle. A basic formula given by Toraldo di Francia (Abstr. 3543/1955) is used, and generalized.

535.317.1

3257. RESPONSE OF OPTICAL SYSTEMS SUFFERING FROM PRIMARY COMA. M.De and B.K.Nath.

Optik, Vol. 15, No. 12, 739-50 (Dec., 1958).

The spatial frequency response is calculated for lines perpendicular to the coma axis of symmetry. Graphs for phase shift and modulation are presented together with the corresponding results on a geometrical optics basis. W.T.Welford

535.317.23

3258. THE CRITICAL RELATIVE APERTURE OF A PHOTOGRAPHIC LENS HAVING SPHERICAL ABERRATION.

V.Blumová and J.Hrdlička.

Czech. J. Phys., Vol. 7, No. 1, 115-17 (1957). In Russian.

535.317.23

3259. WAVE-OPTICAL INVESTIGATION OF APERTURAL DEFECTS. J.Focke.

Optica Acta, Vol. 3, No. 3, 110-26(1956). In German.

The fundamental problem of the wave theory of aberrations is formulated and solved from the wave equation. The approximation to be made for the case of spherical aberration are discussed and attention is directed to a paradox in the energy balance. In order to calculate the distribution of intensity in the image space for large wave aberrations, three different methods are given for points on, near to, or far from, the axis, based essentially on the use of asymptotic expansions. A study is made of the light distribution in the axial caustic of photographic objectives and comparisons are made with experimental results. The question of the optimum correction of spherical aberration is discussed.

535.317.25

3260. RESOLVING POWER AND THE FREQUENCY BAND OF TRUE CONTRAST REPRODUCTION IN OPTICO-PHOTOGRAPHIC IMAGERY. W.Lukosz.

Optik, Vol. 14, No. 11, 490-502 (Nov., 1957). In German.

An approximate formula is suggested for obtaining the combined resolving power of a lens—film system in terms of the bandwidths of the optical system and the photographic emulsion for contrast reproduction above a certain level. W.T.Welford

535.317.6

3261. AUTOMATIC LENS DESIGN BY THE LEAST SQUARES METHOD. J.Meiron.

J. Opt. Soc. Amer., Vol. 49, No. 3, 293-8 (March, 1959).

The method of least squares which permits the simultaneous variation of a large number of design parameters, has been adapted for use with the Weizmann Institute of Science electronic digital computer. The minimization process is iterated until a satisfactory solution is obtained. Two programmes are described, for the correction of third-order aberrations and of residual aberrations respectively. The time required to complete one iteration is 0.5 sec per surface per parameter for the first programme, the corresponding time for the final correction being 3.5 sec. Examples of actual applications of the method for the correction of a Cooke triplet and of a Tessar system are presented.

535.317.7

3262. OPTICAL T-BENCH METHOD OF MEASURING LONGITUDINAL SPHERICAL ABERRATION. F.E.Washer.

J. Res. Nat. Bur. Stand., Vol. 61, No. 1, 31-9 (July, 1958).

A method of measuring longitudinal spherical and chromatic aberration by visual means is described. The method employs an especially constructed optical T-bench equipped with nodal slide and an angle-measuring telescope. The underlying theory of the method is presented, together with a brief description of the apparatus used. The results of measurement on a few typical lenses and an analysis of the sources of error are included.

535.317.7

3263. THE INTENSITY DISTRIBUTION NEAR THE FOCUS OF A PHOTOGRAPHIC OBJECTIVE. G.Schmidt.

Optik, Vol. 15, No. 11, 649-55 (Nov., 1958). In German.

The images of grating test-objects were computed using geometrical optics and also small-angle diffraction theory for an 80 mm f/2.8 Tessar. The results are compared with experimental values obtained by scanning grating images. W.T.Welford

535.318

3264. THE POSSIBILITY OF USING THE GRADATION PROFILE OF A PHOTOGRAPHIC EMULSION FOR ASSESSING THE PERFORMANCE OF OBJECTIVES. F.Hodam.

Optik, Vol. 15, No. 2-3, 153-60 (Feb.-March, 1958). In German.

Examination of the light-distribution over small areas of the photographically-reproduced image of a transmission test-object, formed by the photographic objective under test, is carried out by means of interferential photometry. The results enable the practical performance, and image-forming qualities of the lens to be evaluated. D.R.Barber

535.321

3265. MEASUREMENT OF THE DISPERSION OF LIQUIDS IN THE INFRARED BETWEEN 14 AND 30 μ.

J. Vincent-Geisse, M.Queyrel and J.Lecomte.

C.R. Acad. Sci. (Paris), Vol. 247, No. 21, 1841-3 (Nov. 24, 1958). In French.

An interferometric method previously described (Abstr. 5241/1957) is extended to 30 μ. Curves of refractive index against wavenumber are given for C_6H_6, CCl_4 and $CHCl_3$. G.F.Lothian

535.323 : 539.23

3266. REFRACTIVE INDEX OF NON-UNIFORM FILMS.

O.S.Heavens and J.C.Kelly.

Proc. Phys. Soc., Vol. 72, Pt 5, 906-8 (Nov., 1958).

Variations of refractive index in depth cause the dependence of reflectance on angle of incidence to deviate from the theoretical form. Measurements made near the Brewster angle on Ta_2O_5 film on Ta substrate fitted a curve corresponding to a linear variation of refractive index between 1.95 and 2.15. W.T.Welford

535.324

3267. INFRARED DISPERSION OF CARBON TETRAFLUORIDE.

B.Schurin.

J. chem. Phys., Vol. 30, No. 1, 1-5 (Jan., 1959).

The refractive index of carbon tetrafluoride was measured in the 1-20μ region. The contributions of the molecular vibrations to the index are calculated and the absolute intensities of the infrared active fundamentals obtained. These are:

$$A_3 = (1.60 \pm 0.01) \times 10^{14}\ \mathrm{cm}^{-1}/\mathrm{sec}.$$

$$A_4 = (1.86 \pm 0.13) \times 10^{12}\ \mathrm{cm}^{-1}/\mathrm{sec}.$$

The results are interpreted with the aid of a Urey—Bradley type potential to yield alternate solutions for the dipole moment (μ) of the C--F bond in the molecule and the variation of the moment with internuclear distance $d\mu/dr$. The calculated solutions are:

$$d\mu/dr = 5.599 d/A \qquad \text{or} \qquad d\mu/dr = 3.71 d/A,$$

$$\mu = 1.13 d \qquad\qquad \mu = 2.98 d.$$

The contributions of the infrared bands satisfactorily account for the difference between the static dielectric constant and the square of the refractive index extrapolated to zero frequency from the visible.

535.33.07

3268. INTENSITY AND CLEARNESS OF SPECTRA FROM PRISM INSTRUMENTS WITH RECTANGULAR APERTURE.

K.D.Mielenz.

Optik, Vol. 15, No. 1, 10-29 (Jan., 1958). In German.

The efficiencies of the several methods of slit illumination are discussed. Expressions are deduced for the intensities of both line and continuous spectra observed. An expression is deduced for the variation with slit width of the clearness of a line, defined as its intensity relative to the neighbouring continuum; this is confirmed experimentally for some iron arc lines with a quartz spectrograph. Prism absorption broadens the diffraction image of a line, and the effect of this on clearness is considered. G.F.Lothian

535.33.07 : 535.339

3269. A MONOCHROMATOR BASED ON THE TOTAL REFLECTION BOUNDARY.

O.Hammer and A.Lohmann.

Optik, Vol. 15, No. 1, 30-4 (Jan., 1958). In German.

White light is dispersed by refraction but the desired portion of the spectrum is separated from the rest by utilizing the sharp boundary between total and partial reflection at a glass-air surface. The principle is explained and an experimental arrangement consisting of two rotatable Ba SF5 prisms, the first with its reflection surfaces in contact with benzyl alcohol and therefore suitable for the short wavelength region and the second providing a glass-air surface for the longer wavelengths, is described. A half-width of 300 A and a transparency of 65% were obtained in a test experiment.

S.Weintroub

535.33.07 : 535.417

3270. SPECTROPHOTOMETRY WITH INTERFERENCE FILTERS.

M.Artom and C.Gentile.

R.C. Accad. Naz. Lincei, Vol. 24, No. 6, 709-12 (June, 1958). In Italian.

An interference filter can have a transmission and bandwidth comparable with those of a prism spectrophotometer. A set of 20 filters covering the visible region has been used with a photomultiplier to give a simple spectrophotometer. Results are shown for a number of source-filter combinations. R.W.Fish

535.33.07

3271. DESCRIPTION OF A PHOTOELECTRIC SPECTROMETER DESIGNED FOR A STUDY OF THE NIGHT-SKY SPECTRUM IN THE NEAR INFRARED.

M.Dufay.

Rev. Opt., Vol. 37, No. 9, 467-73 (Sept., 1958). In French.

In this recording spectrophotometer a blazed Bausch and Lomb plane reflection grating with max. efficiency in the first order at $\lambda = 1\ \mu$ is used with a Lallemand 19-stage photomultiplier with Cs–Ag–O cathode. The instrument was designed for use over the spectral range 0.7 to 1.1 μ with max. response at 0.8 μ. The overall accuracy of photoreceiver, mechanical drive to grating, and recorder limits the precision of wavelength records to ~ 5 A.

D.R.Barber

535.33.07 : 621.376.22

3272. 100 kc/s SQUARE WAVE MODULATOR AND RECEIVER FOR STARK EFFECT MICROWAVE SPECTROMETER.

H.G.Fitzky.

Z. angew. Phys., Vol. 10, No. 11, 489-95 (Nov., 1958). In German.

The circuits involved are described in great detail. The bandwidth of the receiver is 2.5 c/s. This is achieved using crystal filters, thus avoiding the need for phase sensitive detectors. Absorption coefficients of 5.10^{-11} cm^{-1} can be detected. E.A.Ash

535.331

3273. GERMANIUM STANDARD WAVELENGTHS IN THE VACUUM ULTRAVIOLET.

K.W.Meissner, R.D.VanVeld and P.G.Wilkinson.

J. Opt. Soc. Amer., Vol. 48, No. 12, 1001-6 (Dec., 1958).

The Ge I lines proposed by Meissner, VanVeld, and Andrew as standards in the vacuum ultraviolet have been investigated with respect to their usefulness as standards. After elimination of nine lines not fit for the purpose there remain 75 lines which can serve as auxiliary standards. These standards were employed for obtaining improved wavelengths in the spectra of Ge I, Ge II, and Ne II. For Ge II improved level values were derived from this measurement which also revealed that the term $8f^2F^0_{5/2,7/2}$ is inverted.

535.331

3274. ARC SPECTRUM OF GERMANIUM.

K.L.Andrew and K.W.Meissner.

J. Opt. Soc. Amer., Vol. 49, No. 2, 146-61 (Feb., 1958).

The spectrum was investigated in the region 1546 A to 11252 A with concave grating spectrographs and interferometers by the use of various arc and hollow cathode sources. Wavelength measurements supplied by other laboratories are included. The wavelength material is greatly improved and extended from 184 lines to 475 lines. Of these about 200 visible and infrared lines were found by the development of a special low pressure Ge arc source. An extended analysis of this spectrum has led to 94 new levels and nearly 300 newly classified lines. At present there are 68 even levels belonging to the $4s^24pnp$ and $4s^24pnf$ configurations and 87 odd levels belonging to the $4s^24pns$, $4s^2pnd$ and $4s4p^3$ configurations. Improved series limit calculations give the value 63 715 ± 10 cm^{-1} for the $4s^24p\ ^2P_{1/2}{}^{\circ}$ level of Ge II with respect to the $4s^24p^2\ ^3P_0$ level of Ge I, corresponding to an ionization potential of 7.899 ± 0.001 V.

535.331

3275. WAVELENGTH AND INTENSITY MEASUREMENTS IN THE SPARE EXCITATED SPECTRUM OF PLUTONIUM.

J.Haaland.

JENER Rep., No. 51, 19 pp. (Aug., 1957).

The wavelength of some four hundred plutonium lines were measured with a Zeiss Abbe-comparator with an estimated accuracy of ±0.01 A. The spectrograms were obtained with a 21 ft 15 000 lines/in. grating spectrograph. Relative intensities of most of the lines were measured photometrically. The spectral sensitivity of the photoplates have been taken into account, and all lines are corrected for background.

535.331

3276. THE MEASUREMENT OF OSCILLATOR STRENGTH ON THE Fe RESONANCE LINE 3720 A FROM THE EXCITATION TIME.

O.Osberghaus and K.Ziock.

Z. Naturforsch., Vol. 11a, No. 9, 762-3 (1956). In German.

The measurement of oscillator strength of the Fe resonance line was undertaken to confirm previous contradictory values. The experiment uses pulsed incident light and measures phase differences between the incident and excited radiation. The previous values of Kopfermann and Wessel were confirmed. Some practical details of the equipment are given. R.W.Fish

535.332

3277. STRUCTURE OF THE SPECTRUM OF SINGLY IONISED BROMINE.

Y.Bhupala Rao.

Indian J. Phys., Vol. 32, No. 11, 497-515 (Nov., 1958).

The earlier analysis is revised in several respects and very much extended. 76 levels belonging to the $4p^4$, $4p^5$, 5s, 4d, 5p, 6s, 5d, and 4f configurations are newly identified involving the classification of nearly 400 additional lines in the region 10 000 A in the photographic infrared to 350 A in the vacuum ultraviolet. This brings the total of classified lines to about 540. Almost all the intense lines are classified except about a dozen and some faint lines. The second ionization potential is established to be 21.80 volts.

535.34

3278. WAVELENGTH CALIBRATIONS IN INFRARED. I. SOME PROBLEMS CONCERNING THE DETERMINATION OF ABSOLUTE POSITIONS OF INFRARED LINES.

K.Narahari Rao, L.R.Ryan and H.H.Nielsen.

J. Opt. Soc. Amer., Vol. 49, No. 3, 216-20 (March, 1959).

Measurements on a few of the infrared lines of water vapour, carbon dioxide, and acetylene are presented. This work was undertaken since in some instances there appeared to be a question about the absolute accuracy of the positions of band lines although good precision was obtained for the relative values. The technique used has enables the values to be tied to the precision data available for the vibration rotation bands of the CO molecule.

535.34

3279. WAVELENGTH CALIBRATIONS IN INFRARED. II. USE OF ATOMIC LINES FROM A HOLLOW CATHODE DISCHARGE TUBE WITH NEON AS CARRIER GAS.

K.Narahari Rao, T.J.Coburn, J.S.Garing, K.Rossmann and H.H.Nielsen.

J. Opt. Soc. Amer., Vol. 49, No. 3, 221-9 (March, 1959).

The possibility of using neon lines excited in a hollow cathode discharge tube for obtaining wavelength calibrations in infrared is explored. The problems involved in making use of these lines for obtaining the relative positions of the rotational lines in vibration rotation bands are discussed. The identifications of the higher order neon lines observed with a 2000 line/in. grating are made available.

535.343

3280. FINE STRUCTURE IN THE ABSORPTION-EDGE SPECTRUM OF Si.

G.G.Macfarlane, T.P.McLean, J.E.Quarrington and V.Roberts.

Phys. Rev., Vol. 111, No. 5, 1245-54 (Sept. 1, 1958).

Measurements of the absorption of Si, made with high resolution near the main absorption edge, at various temperatures between 4.2°K and 415°K, revealed fine structure in the absorption on the long-wavelength side of this edge. This structure was analysed and can be interpreted in terms of indirect transitions involving, in general, phonons with energies corresponding to temperatures of 212°K, 670°K, 1050°K and 1420°K. The form of the absorption associated with each type of phonon indicates that, as well as the formation of free electron-hole pairs taking place, excitons with a binding energy ~ 0.01 eV are produced in the absorption process. The temperature dependence of the indirect energy band gap was found and using this along with data on the intrinsic carrier density indicates an increase with temperature of the combined density-of-states effective mass of the electrons and holes. A smoothing out of the basic features of the curves is observed and shown to be consistent with relaxation broadening. A discussion of the significance of the energies of the phonons taking part in the indirect transitions to the lattice vibrational spectrum of Si is given.

535.343

3281. ABSORPTION SPECTRUM OF FLUORINE IN THE VACUUM ULTRAVIOLET.

R.P.Iczkowski and J.L.Margrave.
J. chem. Phys., Vol. 30, No. 2, 403-5 (Feb., 1959).

A special windowless absorption apparatus and a Lyman discharge light-source were used in combination with a one metre normal incidence spectrograph. A Rydberg series establishes the ionization of F_2 as 15.7 eV. From a progression of bands at 874 A, one can deduce the dissociation energy of fluorine as 37.5 ± 2 kcal/mole. The binding energy of F_2^+ is 3.3 eV. The low value of the ionization potential is consistent with the observed low value of the dissociation energy.

535.343

3282. OPTICAL ABSORPTION OF SILVER CHLORIDE AND SILVER BROMIDE CRYSTALS.

Y.Okamoto.
Nachr. Akad. Wiss. Göttingen, Math.-Phys. Kl. IIa, 1956, No. 14, 275-83. In German.

The halides were used as polished crystals, lamellae, layers prepared by melting, or by evaporation, with thicknesses in the range 22 mm to 0.6 μ. At 293°K there is little structure between 1800 and 3500 A, but curves show a pronounced fine structure observed at 20 and 90°K. The first sharp peak is near 2450 A for AgCl, 2900 A for AgBr. Other curves show the long-wavelength absorption tail measured up to 700°K, with its large movement into the visible spectrum as temperature increases. The narrow low-temperature bands are attributed to excitons as in the alkali halides, and this is confirmed by reasonable agreement with band positions and separations calculated by the Hilsch—Pohl formula for alkali halides. The long-wavelength band resembles that of Ge and is attributed to band-to-band transitions lying on the opposite side of the exciton transitions from that observed for alkali halides.

S.T.Henderson

535.343

3283. SOME OPTICAL PROPERTIES IN THE ULTRAVIOLET OF PURE, VITREOUS GERMANIUM DIOXIDE.

V.Garino-Canina.
C.R. Acad. Sci. (Paris), Vol. 247, No. 5, 593-6 (Aug. 4, 1958). In French.

Two absorption bands occur, at 2050 A and 2450 A. Thermal treatments in air indicate that the bands arise from centres formed by the loss of oxygen in the course of fusion. Two types of centre are involved, rather than two transitions from the same centre.

B.T.M.Willis

535.343

3284. ELECTRONIC SPECTRA OF O-CHLOROPHENOL IN DIFFERENT ENVIRONMENTS AND AT DIFFERENT TEMPERATURES.

S.B.Roy.
Indian J. Phys., Vol. 32, No. 11, 525-33 (Nov., 1958).

Investigations have been carried out on the ultraviolet absorption spectra of pure o-chlorophenol and its solutions in CCl_4, cyclohexane, 3-methyl pentane and isobutyl alcohol at different temperatures. Both the pure liquid and 0.01% solution in CCl_4 show band systems with the 0,0 band at 35475 cm^{-1}, the bands in the former case being much broader. From a comparison of these spectra with those due to the vapour it has been concluded that some of the molecules in the pure liquid and most of the molecules in the solution are of trans configuration. Broadening of the bands in the spectrum due to pure liquid is ascribed to the presence of dimers in the liquid. The spectra due to 0.01% solution in 3-methylpentane or cyclohexane are found to consist of a strong system of bands accompanied by a much weaker system displaced from the former towards higher energies by 346 cm^{-1}. The stronger system has been assigned to trans molecules and the weaker one to molecules which form H—Cl bonds with neighbouring solvent molecules. The spectrum due to 0.01% solution in isobutyl alcohol shows a band system shifted towards longer wavelengths with respect to that in the case of the pure liquid by about 400 cm^{-1}. This unusually large shift towards red has been accounted for by assuming a strong interaction between solvent and solute molecules resulting in the formation of a compound similar to a trisubstituted benzene compound.

535.343

3285. EFFECTS OF HIGH PRESSURE ON THE NEAR ULTRAVIOLET VAPOR ABSORPTION SPECTRUM OF BENZENE IN A NUMBER OF DILUENT GASES.

S.E.Babb, Jr, J.M.Robinson and W.W.Robertson.
J. chem. Phys., Vol. 30, No. 2, 427-34 (Feb., 1959).

The absorption spectrum of benzene vapour in a number of gaseous diluents over a wide range of diluent densities was obtained. The wavelength of absorption shifts to the red in the gases A, H_2, N_2, CO_2, O_2, CO, C_2H_6, and C_2H_4, to the blue in the diluents He and Ne. Since the light absorber is the same in each case, the relative rates of shift with density should be a function of the physical properties of the diluents. However, no simple correlation has been found to exist between relative shift and such properties of the solvents as polarizability or dielectric constant. Dispersion theory predicts only roughly the relative shifts. No satisfactory explanation has been found for the blue shift obtained in He and Ne.

535.343 : 535.371

3286. THE LOWEST OPTICAL EXCITED STATES OF NAPHTHALENE CRYSTALS.

D.Griessbach, G.Will and H.C.Wolf.
Z. Naturforsch., Vol. 11a, No. 10, 791-6 (1956). In German.

Measurements are reported of the absorption and fluorescence bands at 100°K in the region 30 000-37 000 cm^{-1}, with polarizations parallel and perpendicular to the a and b axes. A term scheme of excited electron levels and vibrational sublevels is given. The 0—0 level shows Davydov splitting into two components separated by about 150 cm^{-1}.

G.F.Lothian

535.343 : 535.371

3287. A SIMPLE THEORY OF THE LOWEST OPTICAL EXCITED STATES OF MOLECULAR CRYSTALS.

H.C.Wolf.
Z. Naturforsch., Vol. 11a, No. 10, 797-800 (1956). In German.

A semi-classical theory is outlined in which the excited molecule, considered as an oscillating dipole, interacts with a neighbouring unexcited molecule to give the Davydov splitting. The measurements of the previous paper (see preceding abstract) may then be used to give the number of molecules in the unit cell, the magnitude of the interaction energy and the disposition of the transition moment of the single molecule.

G.F.Lothian

535.343

3288. THE STRUCTURE OF THE ABSORPTION SPECTRUM OF KCl AND NaCl CONTAINING TRACES OF AgCl.

R.Bubáková.
Czech. J. Phys., Vol. 7, No. 1, 110-11 (1957). In Russian.

535.343 : 535.37 : 539.2

EXCITON SPECTRA AND POLYMORPHISM OF SILVER IODIDE.

See Abstr. 2922

535.343 : 535.37 : 539.2

ABSORPTION SPECTRA OF BENZENE AND NAPHTHALENE.

See Abstr. 2923

535.343

3289. ABSORPTION SPECTRUM OF ARSENIC DOPED SILICON.

H.J.Hrostowski and R.H.Kaiser.
J. Phys. Chem. Solids, Vol. 7, No. 2-3, 236-9 (Nov., 1958).

The absorption spectrum of arsenic doped silicon was obtained and is in good agreement with that calculated from the effective mass theory. Bands which do not obey the calculated term scheme are shown to arise from other donor impurities. Optical and thermal ionization energies appear to be very similar for Group III and Group V impurities.

535.343

3290. PRESSURE MODULATION OF INFRARED ABSORPTION. II. INDIVIDUAL LINES IN VIBRATION-ROTATION BANDS.

J.C.Gilfert and D.Williams.
J. Opt. Soc. Amer., Vol. 49, No. 3, 212-16 (March, 1959).

For Pt I, see Abstr. 2213 (1959). The grating spectra of several gases subject to periodic pressure variations were studied in the near infrared. In the modulated spectra the absorption lines associated with transitions between the higher rotational levels are enhanced as compared with the corresponding lines in conventional spectra. This effect is interpreted in terms of periodic population and depopulation of the upper rotational levels as a result of temperature variations occurring during the modulation cycle. Quantitative comparison of the observed total absorption of the lines of the R-branch of the CO fundamental with the total absorption calculated on the basis of an adiabatic cycle was satisfactory. Possible application of pressure modulation techniques to other problems of infrared spectroscopy is discussed.

535.343

3291. VIBRATION-ROTATION BANDS OF AMMONIA. I. THE COMBINATION BANDS $\nu_2 + (\nu_1, \nu_3)$.

W.S.Benedict, E.K.Plyler and E.D.Tidwell.

J. Res. Nat. Bur. Stand., Vol. 61, No. 3, 123-47 (Sept., 1958).

A general discussion is given of methods used in the analysis of NH_3 vibration–rotation spectra, including the derivation of molecular constants and the determination of line strengths and line widths. Results are given for the region 2.15 to 1.48 μ (4060 to 4700 cm^{-1}), in which more than 800 lines have been measured. These have been analysed into the inversion-doubled perpendicular combination band $\nu_2 + \nu_3$ (ν_0 = 4416.908 and 4434.610 cm^{-1}; band strength = 19.7 $cm^{-2}\,atm^{-1}$) and the inversion-doubled parallel combination band $\nu_1 + \nu_2$ (ν_0 = 4293.716 and 4320.060 cm^{-1}; band strength = 2.9 $cm^{-2}\,atm^{-1}$). Complete energy levels for these bands have been found up to J = 12 and 10, respectively, permitting determinations of molecular constants, which include numerous higher-order effects involving the interaction of rotation, vibration, and inversion. The line widths range from a maximum of 0.57 $cm^{-1}\,atm^{-1}$, when K = J, to a minimum of < 0.2 $cm^{-1}\,atm^{-1}$, when $K \ll J$.

535.343

3292. ON THE INFRARED ABSORPTION SPECTRA OF CRYSTALLINE BRUCITE [$Mg(OH)_2$] AND PORTLANDITE [$Ca(OH)_2$]. R.M.Hexter.

J.Opt. Soc. Amer., Vol. 48, No. 11, 770-4 (Nov., 1958).

The infrared spectrum of $Mg(OH)_2$ single crystals reported by Mara and Sutherland (Abstr. 279/1954, 7294/1956) is discussed in detail from the point of view of considering the effect of a small twofold crystalline field on the rotational levels of the OH^- molecule ion. The spectrum may be reasonably accounted for by a ~ 350 cm^{-1} barrier, with respect to the position, polarization, and temperature dependence of its many lines.

535.343

3293. INFRARED ABSORPTION INTENSITIES OF HEXAFLUOROBENZENE. D.Steele and D.H.Whiffen.

J. chem. Phys., Vol. 29, No. 5, 1194-5 (Nov., 1958).

A preliminary note on the intensities of the fundamentals in the infrared spectra. R.C.Seymour

535.343 : 535.375.5

3294. INFRARED AND RAMAN SPECTRA OF FLUORINATED ETHYLENES. IX. 1,1-DIFLUORO-2-CHLORO-2-BROMOETHYLENE. R.Theimer and J.R.Nielsen.

J. chem. Phys., Vol. 30, No. 1, 98-102 (Jan., 1959).

For Pt VIII see Abstr. 9086 (1957). The infrared absorption spectrum of gaseous $CF_2{:}CClBr$ was obtained with a double-pass spectrometer equipped with LiF, CsBr, and NaCl prisms and a 1 m absorption cell. The Raman spectrum of the compound in the liquid state was photographed with a 3-prism glass spectrograph of reciprocal linear dispersion 15 A/mm at 4358 A. The 12 vibrational fundamentals are assigned as follows: species a': 1731, 1314, 1022, 945, 613, 455, 358, 219, and 166 cm^{-1}; species a'': 566, 324, and ~ 155 cm^{-1}. The two lowest a'' fundamentals are rather uncertain. The observed spectra are interpreted in detail. Thermodynamic properties for the ideal gaseous state at 1 atm have been calculated for 6 temperatures.

535.343 : 539.19

3295. VIBRATIONAL SPECTRA AND STRUCTURE OF OXAMIDE AND DITHIOOXAMIDE. T.A.Scott, Jr and E.L.Wagner.

J. chem. Phys., Vol. 30, No. 2, 465-9 (Feb., 1959).

The infrared spectra of sublimed films of oxamide, dithiooxamide, and their deuterium analogues were obtained at −190° and 25°C in the region from 4000 to 400 cm^{-1}. These spectra are consistent with the X-ray data and satisfactory vibrational assignments were made on the basis of molecules with planar trans heavy-atom structures with over-all site symmetries C_i but close to C_{2h}. An increase in frequency of ν(CN) on deuteration accompanied by too large a decrease in $\delta(ND_2)$ results from a strong mixing of these stretching and bending modes and from Fermi type resonances. Only ordinary hydrogen bonds were found so that the unusually high melting points of these compounds are due to a fortuitous combination of several factors related to their layer structures rather than to very strong hydrogen bonding alone.

535.343 : 539.19

3296. FAR INFRARED SPECTRUM AND THE BARRIER TO INTERNAL ROTATION IN 1,1,1,2-TETRAFLUOROETHANE.

A.Danti and J.L.Wood.

J. chem. Phys., Vol. 30, No. 2, 582-4 (Feb., 1959).

The spectrum of the gas was examined in the far infrared (50-420 cm^{-1}). Bands were observed at 120, 225, 350, and 409 cm^{-1}. The contour of the strong band at 120 cm^{-1} is consistent with that to be expected for the torsional oscillation. This frequency would correspond to a triple cosine barrier of 4.2 kcal/mole.

535.343 : 539.19

3297. SPECTROSCOPIC DETERMINATION OF THE ABSOLUTE BOND MOMENT OF THE CH BOND IN LONG HYDROCARBON CHAINS. O.Theimer.

Z. Naturforsch., Vol. 11a, No. 10, 883-4 (1956). In German.

Measurements of the intensities of the infrared absorption bands at 2919, 2851 and 1370 cm^{-1} are reported. The intensity of the 1370 cm^{-1} band is extrapolated to the value for an infinite chain to obtain the CH_2 wagging intensity. Comparison with the CH intensities leads to $\mu^H = 0.09 \pm 0.01$ debye. R.F.Barrow

535.343

3298. RECENT DETERMINATIONS OF ATOMIC MASS RATIOS BY MICROWAVE SPECTROSCOPY.

B.Rosenblum, C.H.Townes and S.Geschwind.

Rev. mod. Phys., Vol. 30, No. 2(I), 409-11 (April, 1958).

Discusses small corrections for electronic effects on rotational frequencies of diatomic molecules, in particular the contribution of the electrons to rotational kinetic energy and the "wobble stretching" effect (Abstr. 9074/1958). With such corrections included, microwave values for mass ratios are as accurate as those obtained by other methods: a review of recent work on HI, CO, CS and RbCl is given. J.Hawgood

535.343 : 539.19

3299. MICROWAVE SPECTRA OF MOLECULES EXHIBITING INTERNAL ROTATION. V. BARRIER HEIGHT IN ETHYL CHLORIDE AND ETHYL BROMIDE. D.R.Lide, Jr.

J. chem. Phys., Vol. 30, No. 1, 37-9 (Jan., 1959).

For Pt IV, see Abstr. 1291 (1959). The barriers to internal rotation in C_2H_5Cl and C_2H_5Br were determined from the splittings of microwave lines in the first excited torsional state. The values obtained are $V_0 = 3560 \pm 12$ cal/mole for C_2H_5Cl and $V_0 = 3567 \pm 30$ cal/mole for C_2H_5Br. The influence of nuclear quadrupole hyperfine structure on the torsional splittings is discussed.

535.343 : 539.19

3300. MICROWAVE SPECTRUM, STRUCTURE, AND DIPOLE MOMENT OF CYCLOPROPENE.

P.H.Kasai, R.J.Myers, D.F.Eggers, Jr and K.B.Wiberg.

J. chem. Phys., Vol. 30, No. 2, 512-16 (Feb., 1959).

The microwave spectra of four isotopic species of cyclopropene, $CH_2(CH)_2$, CH_2CDCH, $CH_2(CD)_2$, and $CDH(CH)_2$ were assigned and three rotational constants for each isotopic species determined. From these data the following structural parameters are evaluated: C–C 1.515 A, C=C 1.300 A, C–H (methylene) 1.087±0.004 A, C–H (vinyl) 1.070 A, H–C–H angle 114°42'±10' and C=C–H angle 149°55'. The uncertainties in the methylene values are the magnitude of a rotation–vibration interaction correction. The dipole moment of cyclopropene was found to be 0.455±0.01 Debye unit.

535.345

3301. THE EFFECT OF PRESSURE ON THE OPTICAL ABSORPTION EDGE OF GERMANIUM AND SILICON.

T.E.Slykhouse and H.G.Drickamer.

J. Phys. Chem. Solids, Vol. 7, No. 2-3, 210-13 (Nov., 1958).

The shift of the optical absorption edge with pressure was measured in germanium and silicon to over 100 000 atmospheres. In germanium there is an initial blue shift which reverses at 50 000 atm at $\alpha \cong 20$ cm^{-1} (35 000 atm at $\alpha = 0$). Silicon exhibits a continuous red shift. The data in the low pressure region are consistent with those of other investigators. Evidently the minimum in the conduction band in the ⟨111⟩ direction shifts to higher energy with increasing pressure, while the minimum in the ⟨100⟩ direction shifts to lower energies (relative to the valence band). At one atmosphere the minimum in ⟨111⟩ direction in germanium lies about 0.2 eV above the minimum in the ⟨100⟩ direction which is consistent with previous estimates.

535.345 : 539.2

3302. ABSORPTION OF LIGHT BY COLLOIDS IN ALKALI HALIDE CRYSTALS. W.T.Doyle.
Phys. Rev., Vol. 111, No. 4, 1067-72 (Aug. 15, 1958).

The thermal transformation of F centres into colloid has been observed in NaCl. The transformation occurs with constant integrated absorption cross-section. The shape of the band depends upon the temperature at which the colloid is formed. A theory of the colloid band based upon the free electron model of the alkali metal and Mie's theory of the absorption of light by conducting spheres is presented. The theory makes assertions concerning the integrated absorption, maximum absorption, band width, and band position which are compared with experiment.

535.345 : 539.2

3303. OPTICAL ABSORPTION OF Cl_2^- MOLECULE-IONS IN IRRADIATED POTASSIUM CHLORIDE.
C.J.Delbecq, B.Smaller and P.H.Yuster.
Phys. Rev., Vol. 111, No. 5, 1235-40 (Sept. 1, 1958).

Pure KCl, KCl—Ag, KCl—Tl and KCl—Pb after X-ray irradiation at liquid nitrogen temperature, show identical Cl_2^- paramagnetic resonance spectra. The optical absorption of the Cl_2^- molecule-ion has been identified and is found to consist of two bands, one at 365 $m\mu$ and one at 750 $m\mu$. This identification was made possible by bleaching irradiated samples with polarized light and observing the effects on the optical and also the paramagnetic resonance spectra. It was possible to reorient the Cl_2^- molecule-ions such that a large fraction of them were in only one of the six possible ⟨110⟩ directions.

535.345 : 539.2

3304. OPTICAL PROPERTIES OF n-TYPE InP. R.Newman.
Phys. Rev., Vol. 111, No. 6, 1518-21 (Sept. 15, 1958).

Measurements of the intrinsic absorption edge of n-type InP at 77°K and 300°K are reported. Differences are found in the spectra of samples of differing origin. The effects are believed due to impurities. Reflection and absorption spectra in the vicinity of the reststrahlen peak are shown. The reststrahlen wavelength is 30.5μ, the static and high-frequency dielectric constants are $\epsilon_0 = 15$ and $\epsilon_\infty = 10.6$. Free-carrier absorption and reflection spectra are shown. A brief discussion of the implications of the various optical and electrical measurements as regards the conduction band structure is given.

535.345 : 539.2

3305. THE POSITION OF THE ABSORPTION BANDS OF IMPURITY CENTRE ELECTRONS IN IONIC LATTICES.
H.D.Koswig and O.Stasiw.
S.B. Dtsch. Akad. Wiss. Berlin, Kl. Math. Phys. Tech., 1957, No. 2 (publ. 1958), 11 pp. In German.

If ν is the frequency for maximum absorption, d is the shortest distance between two ions in the lattice and R is the ionic radius of the impurity then, for O^{2-}, S^{2-}, Se^{2-} and Te^{2-} in AgBr and AgCl, the empirical relation $\nu d^2 = aR - bR^2$ has been observed with a and b as constants which are independent of the lattice and the impurities. The value of ν for colour centres can be associated with $R = a/2b$. R.Stratton

535.345 : 537.312.5

PHOTOCONDUCTIVITY AS A FUNCTION OF OPTICAL ABSORPTION. See Abstr. 2339

535.345 : 539.2

INFRARED ABSORPTION BY SODIUM CHLORIDE-TYPE LATTICES. See Abstr. 2924

535.36

3306. MATRIX FORMALISM IN THE THEORY OF DIFFUSION OF LIGHT. I.Kuščer and M.Ribarič.
Optica Acta, Vol. 6, No. 1, 42-51 (Jan., 1959).

Matrices are introduced into the transport equation, in order to account for polarization effects. The necessary transformation of the scattering matrix is carried out by developing its components (in an appropriate representation) in generalized spherical functions. A calculation of the diffusion length may serve as an example for the application of this formalism.

535.361.2

3307. A NOTE ON THE COEFFICIENT OF REFLECTION FOR INTERNALLY INCIDENT DIFFUSE LIGHT. R.G.Giovanelli.
Optica Acta, Vol. 3, No. 3, 127-30 (Sept., 1956).

It is shown experimentally that for uniformly diffuse radiation incident internally on the surface of a medium of refractive index greater than unity, the reflectance is almost independent of the nature of the surface. Values of the diffuse reflectance are discussed for non-uniformly diffuse radiation incident internally on the surfaces of semi-infinite and plane parallel media subjected to different modes of illumination. Some confirmatory measurements are included.

535.361.2 : 551.593.5

3308. ON THE DIFFUSE REFLECTION OF A PENCIL OF RADIATION BY A PLANE-PARALLEL ATMOSPHERE.
S.Chandrasekhar.
Proc. Nat. Acad. Sci. U.S.A., Vol. 44, No. 9, 933-40 (Sept., 1958).

The basic problems which arise when a narrow pencil of radiation (such as a searchlight beam) is incident on a plane-parallel atmosphere have only been solved approximately in a few cases (Abstr. 1190/1957). To test the effectiveness of the approximate methods it would be useful to compare them with an exact solution. This paper gives such a solution for the problem of the diffuse reflection of an infinitesimal pencil of radiation of finite flux incident in some direction and at some point on an isotropically scattering, uniform, semi-infinite atmosphere. The treatment is mathematical and an equation for the scattering function is derived by a method based on invariances. H.G.Jerrard

535.37 : 539.18

3309. ON MULTIPLE TRANSITIONS AND THERMAL IONIZATION OF LOCALIZED LEVELS IN THE CONFIGURATIONAL CURVE MODEL. D.Curie.
C.R. Acad. Sci. (Paris), Vol. 247, No. 21, 1843-6 (Nov. 24, 1958).
In French.

Annihilation and creation operators, which fix the permitted transitions between states of a single oscillator with absorption or emission of a vibrational quantum, allow both absorption and emission of a number of quanta in transitions between the states of two oscillators whose equilibrium position is disturbed.
G.F.J.Garlick

535.37

3310. ENERGY TRANSFER IN ZnS : Cu : Cl PHOSPHORS.
N.T.Melamed.
J. Phys. Chem. Solids, Vol. 7, No. 2-3, 146-52 (Nov., 1958).

The transfer of energy from blue to green emitting centres was studied in ZnS : Cu : Cl phosphors. It appears that energy can be transported even at low temperatures and low impurity concentrations. An estimate of the energy transfer expected from a resonance process through electric dipole--dipole interaction, yields values for energy transfer which are much lower than those observed. Several possible transfer mechanisms are discussed.

535.37

3311. POLARIZED LUMINESCENT EMISSION FROM KCl : Tl AT LOW TEMPERATURES. C.C.Klick and W.D.Compton.
J. Phys. Chem. Solids, Vol. 7, No. 2-3, 170-4 (Nov., 1958).

At temperatures near that of liquid helium, polarized emission is observed from isolated thallium centres in KCl with a polarization $P = 0.2$. The centre responsible for this effect has its maximum emission along the cubic axis. The polarization does not appear at liquid nitrogen temperatures and it is not dependent on the concentration of thallium. Arguments are given which make it seem unlikely that this effect is due to crystal strain or the proximity of the luminescent centre to other imperfections. It is possible that there is a splitting of the levels of the excited state of thallium due to the Jahn—Teller effect. Comparison is made of the experimental results with the theory of the Jahn—Teller effect developed by Van Vleck and by Öpik and Pryce. Difficulties with this interpretation are discussed. In contrast to the thallium centre, polarization is not found for luminescent emission from F-centres in KCl at temperatures near liquid helium.

535.37 : 535.343 : 539.2

LUMINESCENCE SPECTRA OF BENZENE AND NAPHTHALENE. See Abstr. 2923

535.37 : 539.2

LUMINESCENCE SPECTRA OF MINERAL CRYSTALS. See Abstr. 2919

535.37 : 539.2

LUMINESCENCE SPECTRUM OF CdS. See Abstr. 2921

535.37 : 535.343 : 539.2

EXCITON SPECTRA AND POLYMORPHISM OF SILVER IODIDE. See Abstr. 2922

535.371 : 534.39

3312. ACTION OF ULTRA-SOUND ON THE LUMINESCENCE OF ZINC SULPHIDE SCREENS UNDER CONTINUOUS EXCITATION BY LIGHT. M.Leistner.

Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 129-41 (1957). In German.

Screens of ZnS or ZnCdS, with Cu or Ag activator, were exposed to a source of 800 kc/s (maximum power 3.6 W) while continuously excited by blue or u.v. light. With phosphors having afterglow, the commencement or increase of ultra-sound gave a sudden peak above the steady emission, and a sudden temporary quenching resulted from the stopping or decreasing of ultra-sound. Non-phosphorescent screens suffered a permanent partial quenching under ultra-sound, with a gradual return to the original level of emission on discontinuance. A simple theory based on the emptying the electron traps by ultra-sound leads to conclusions that the increase of intensity ΔL should be proportional to the original intensity up to a certain level, and then become constant; that relations of exponential form should occur between ΔL and the length of prior illumination of the phosphor, and between ΔL and the power of ultra-sound used; and similarly for quenching in the case of phosphorescent materials. These relations were confirmed by experiment. For non-phosphorescent materials comparable relations were applicable, and in this case the quenching is explained by removal to the conduction band of electrons in excited states just below the band, so that they cannot participate in luminescent transitions of the kind postulated by Lambe and Klick. S.T.Henderson

535.371 : 539.2

3313. ELECTRONIC PROCESSES IN THE LUMINESCENCE OF IONIC CRYSTALS. A.Meessen.

Ann. Soc. Sci. Bruxelles I, Vol. 71, No. 3, 222-46 (1957). In French.

An elementary account of energy band theory for crystals is followed by a discussion of the mechanism of excitation, modes of luminescent decay, and thermoluminescence. The application of configuration coordinates to the phenomena of absorption and emission, trapping states and thermal quenching is discussed simply, and concentration quenching is briefly considered.

S.T.Henderson

535.371 : 539.21

3314. MODELS FOR LUMINESCENCE DEGRADATION IN ORGANIC SOLIDS. H.B.Rosenstock and J.H.Schulman.

J. chem. Phys., Vol. 30, No. 1, 116-25 (Jan., 1959).

The damage versus dose relationship for radiation damage in organic solids is computed on the basis of several models, and the results are compared with experimental data reported by various workers. Two models are amenable to analytical treatment: (1) after a hit, all molecules within a given sphere centred about the hit molecule are poisoned, and none outside, and (2) there is a constant probability that excitation of any molecule throughout the crystal will result in quenching independent of its distance from the hit molecule. The fact that experiment agrees with the result of the latter model, but disagrees with the former, implies that the damage mechanism has a very large range. A lower limit of approximately 1000 angstroms, corresponding to 3×10^4 jumps of the excitation energy among neighbouring molecules is found as a requirement for consistency with the latter model.

535.371

3315. POLARIZATION OF THE PHOSPHORESCENCE OF NAPHTHALENE AND PHENANTHRENE. R.Williams.

J. chem. Phys., Vol. 30, No. 1, 233-7 (Jan., 1959).

The substances were dissolved in EPA glass at 77°K and irradiated with plane polarized exciting light sufficiently monochromatic to be absorbed by only a single electronic transition. The phosphorescence transition is perpendicular to the plane of the ring for phenanthrene and lies in the plane of the ring along the short axis for naphthalene. Comparison of observed polarizations with those predicted for various assignments of the lowest triplet shows that no assignment can be made in the case of phenanthrene. An assignment may be possible in the case of naphthalene though it is subject to uncertainty because of the contribution to the emission intensity which may be due to vibrationally induced transitions.

535.371

3316. ACTIVATION OF ZnS AND (Zn,Cd)S PHOSPHORS BY GOLD AND OTHER ELEMENTS.

S.T.Henderson, P.W.Ranby and M.B.Halstead.

J. Electrochem. Soc., Vol. 106, No. 1, 27-34 (Jan., 1959).

A study has been made of the spectral emission characteristics of zinc and zinc—cadmium sulphide phosphors, activated by gold and excited by long wave ultraviolet at 25° and −120°C. The positions and heights of the Gaussian sub-bands constituting the emission were examined and compared with those derived from the series activated by copper, silver, and chloride ("self-activated"). Coppe and gold produce the most similar phosphors, with 3 sub-bands eac silver and chloride give 2 sub-bands, and resemble each other particularly in the effects associated with crystallographic change. Linear relations in the peak locations and an energy diagram are discussed. Other observations concern cathode-excitation, the effects of substituting selenium for sulphur, and a recently reported emission band of higher frequency.

535.371 : 621.385.832.032.3

3317. DEVELOPMENT AND APPLICATIONS OF TRANSPAREN CATHODE-RAY TUBE SCREENS. C.Feldman.

J. Soc. Motion Picture Televis. Engrs, Vol. 67, No. 7, 455-60 (July, 1958).

The optical properties of cathode-ray tube screens are discussed. A grain size too small to scatter light is desirable for improv contrast and resolution, and may be achieved by evaporation of phosphors in vacuo on to glass or silica. Details are given for eight phosphors evaporated between 1000° and 2000°C, followed by heat treatment to a lower temperature to reconstitute dissociated phosphors and to rediffuse the activator. A top conducting layer is required. Brightness loss is about half compared with conventional screens. Some applications are mentioned, including laminated screens for colour television in which different layers are excited according to the penetration of the electron beam. Discussion of the paper is included. S.T.Henderso

535.371

3318. ON THE QUESTION OF THE FLUORESCENCE YIELD OF SODIUM SALICYLATE IN THE U.V. AND X-RAY REGION.

E.Krokowski.

Naturwissenschaften, Vol. 45, No. 21, 509-10 (1958). In German.

The yield of X-ray fluorescence from a screen of sodium salicylate is calculated to be 0.04 from the total light energy emitted and the X-ray energy absorbed. It is shown that the ratio of light energy to total X-ray energy converted into secondary electrons is constant, and the yield is thus independent of the secondary electron energies. Previous work on the ultraviolet fluorescence is quoted (Abstr. 1497/1953). The quantum efficiency is unity for excitation between 3500 and 150 A. Below this range a constant 4% of the absorbed energy is converted into light, as in the X-ray region (1 to 0.01 A). S.T.Henderson

535.371

3319. QUENCHING, STIMULATION, AND EXHAUSTION STUDIES ON SOME INFRARED STIMULABLE PHOSPHORS.

S.P.Keller and G.D.Pettit.

Phys. Rev., Vol. 111, No. 6, 1533-9 (Sept. 15, 1958).

As a continuation of earlier work (Abstr. 2985/1958) on the two phosphor systems SrS:Ce, Sm and SrS:Eu,Sm, studies of the quenchings and the enhancements of fluorescent emission by visible and infrared radiation have been made. Two stimulation bands were measured and the relative efficiencies of exhaustion and of stimulation of visible emissions by the two bands were studied. These data were correlated with the simplified band-theory model that had been proposed earlier. The measurements indicate that the two stimulation bands are associated with the same centre. This can be represented by the assignment, to that centre, of two energy levels within the energy gap.

535.371

3320. THE COLOUR AND LUMINESCENCE OF FELDSPARS, WITH AN APPENDIX: THE REVERSIBLE FLUORESCENCE ON ANNEALING ANHYDRITE. K.Przibram.

S.B. Österr. Akad. Wiss. mat.-nat. Kl. Abt. II, Vol. 165, No. 5-7, 281-311 (1956). In German.

The green colour of amazonite is due to radiation, the red-brown colour of some feldspars is caused by impurities. Most feldspars emit a green fluorescence, largely due to adsorbed water, Eu often causes blue fluorescence. Measurements were made of the fluorescence on heating and cooling of feldspars, anhydrite, wollastonite and gypsum. J.Franks

535.371

3321. ON THE TEMPERATURE REVERSIBILITY OF THE FLUORESCENCE OF MINERALS AND CHEMICALS. K.Przibram.

S.B. Osterr. Akad. Wiss. mat.-nat. Kl. Abt. II, Vol. 166, No. 6-10, 111-23 (1957). In German.

See Abstr. 6029-30 (1957). R.A.Newing

535.371

3322. LUMINESCENCE IN THE STANNATE GROUPS. K.T.Wilke.

Z. phys. Chem. (Leipzig), Vol. 208, No. 5-6, 361-7 (April, 1958). In German.

It is shown that only two compounds of the stannate groups show fluorescence: Mg_2SnO_4—Mn and Ba_2SnO_4. The preparation and emission characteristics of specimens in each group are listed. The manganese centre emission is usually green, but a red emission is associated with high MgO content. G.F.J.Garlick

535.371 : 535.343

THE LOWEST OPTICAL EXCITED STATES OF NAPHTHALENE CRYSTALS. See Abstr. 3286

535.371 : 535.343

A SIMPLE THEORY OF THE LOWEST OPTICAL EXCITED STATES OF MOLECULAR CRYSTALS. See Abstr. 3287

535.372

3323. INFRARED FLUORESCENCE OF COPPER-ACTIVATED ZINC SULPHIDE PHOSPHORS. G.Meijer.

J. Phys. Chem. Solids, Vol. 7, No. 2-3, 153-8 (Nov., 1958).

An infrared fluorescence was observed for ZnS : Cu, Al and ZnS : Cu, Ga at 1.57 μ and 1.72 μ. This emission appeared to be excited at low temperatures by radiation of 1.38 μ and between 0.5 μ and 0.8 μ, provided that the phosphor was excited by 3650 A. The infrared quenching of the visible fluorescence and an infrared stimulation of the visible phosphorescence show a spectrum analogous to the infrared excitation spectrum, and seem to be connected with the same transitions.

535.373 : 537.226.3

3324. PHOSPHORESCENCE AND PHOTODIPOLAR EFFECT.

E.Grillot and R.Freymann.

Wiss. Z. Hochsch. Elektrotech. Ilmenau, Vol. 4, No. 1, 11-15 (1958). In French.

A discussion is given of dielectric constant and loss changes in phosphors due to excitation. Results for variation in dielectric loss change with applied field frequency and temperature are given for zinc and cadmium sulphides. Explanations are given in terms of the behaviour of trapped electrons. G.F.J.Garlick

535.375

3325. A PHOSPHOR MODEL ON A QUANTUM-MECHANICAL BASIS. I. ELECTRON AND PHONON REACTION KINETICS. II. TRANSITION MATRICES OF THE QUENCHING CENTRE. III. TRANSITION PROBABILITIES FOR STEADY PERTURBATION AND DISCRETE SPECTRA. IV. ENERGY DISSIPATION OF OPTICAL ION OSCILLATIONS. H.Stumpf.

Z. Naturforsch., Vol. 12a, No. 2, 153-67; No. 6, 465-78 (1957); Vol. 13a, No. 3, 171-83 (March); No. 8, 621-42 (Aug., 1958).

535.376 : 539.1.07

3326. LIQUID SCINTILLATORS: ATTRIBUTES AND APPLICATIONS. F.N.Hayes.

Internat. J. appl. Radiation and Isotopes, Vol. 1, No. 1-2, 46-56 (July, 1956).

Comprehensive review. 22 references.

535.376 : 539.1.07

3327. LIQUID SCINTILLATORS III. THE QUENCHING OF LIQUID-SCINTILLATOR SOLUTIONS BY ORGANIC COMPOUNDS.

V.N.Kerr, F.N.Hayes and D.G.Ott.

Internat. J. appl. Radiation and Isotopes, Vol. 1, No. 4, 284-8 (Jan., 1957).

For Pt II, see Nucleonics, Vol. 14, No. 1, 62 (1956). A study was made of the quenching characteristics of a large number of selected organic compounds in a few commonly encountered liquid scintillator solutions. From this it should be possible to anticipate the quenching difficulties associated with homogeneous liquid scintillation counting.

535.376

3328. THE INFLUENCE OF CHAIN LENGTH ON THE LUMINESCENT OUTPUT OF PLASTIC SCINTILLATORS.

B.L.Funt and A.Hetherington.

Internat. J. appl. Radiation and Isotopes, Vol. 4, No. 3-4, 189-95 (Jan., 1959).

The influence of chain length on the luminescent efficiency of plastic scintillators was studied over a wide range of molecular weights. By varying the temperature of polymerization and by employing chain transfer agents, samples with molecular weights ranging from 10^3 to 10^6, determined by intrinsic viscosity measurements, were obtained. The results indicate that the chain length has negligible influence on the luminescent efficiency for molecular weights in excess of 100 000. For lower molecular weights a sharp dependence of light output on chain length is found. The use of polymerization initiators does not lower the molecular weight to the region of critical dependence and it is concluded that the quenching effects of such substances are not due to the lower molecular weights that are concomitant with their use. The influence of various solutes on the molecular weight of resultant polymers was investigated. No evidence of chemical interaction could be found from molecular weight determination or from absorption spectra of the purified polymers. These results weighed against the acceptance of copolymerization or chain transfer as a significant factor in the polymerization process.

535.376

3329. METAL LOADED SCINTILLATOR SOLUTIONS.

A.R.Ronzio.

Internat. J. appl. Radiation and Isotopes, Vol. 4, No. 3-4, 196-200 (Jan., 1959).

The scintillation efficiencies of various scintillating solutions containing hydrocarbon soluble salts of cadmium, lead, bismuth, uranium, and iron were compared. The directions for the preparation of the salts are given. The pulses obtained from caesium-137 were compared by means of a pulse height analyser.

535.376 : 539.1.07

3330. LIQUID SCINTILLATORS CONTAINING METALLIC IONS.

R.C.Axtmann and LeC.Cathey.

Internat. J. appl. Radiation and Isotopes, Vol. 4, No. 3-4, 261 (Jan., 1959).

By loading toluene with tri-n-butyl phosphate which dissolves salts of the actinide and rare earth elements, as well as many lighter elements, it is possible to retain scintillation efficiency with large amounts of the dissolved salts. This provides a good internal counter system for α- and β-active materials. G.F.J.Garlick

535.376 : 537.29

3331. ELECTROPHOTOLUMINESCENT AMPLIFICATION.

R.E.Halsted.

J. appl. Phys., Vol. 29, No. 12, 1706-8 (Dec., 1958).

Alternating electric fields can modify the time distribution of luminescent recombination in sulphide-type phosphors with the expenditure of less electrical energy than is contained in the fluctuating component of the emitted visible radiation. Within the range of excitation and electrical signal input conditions where this is true, the phosphor sample may be regarded as an amplifier deriving its power from incident radiation, which can convert an applied electrical signal into an output light signal with energy gain and frequency fidelity.

535.376 : 539.1.07

3332. A MATRIX TO CORRECT FOR SCINTILLATOR ESCAPE EFFECTS. E.G.Rawson and D.V.Cormack.

Nucleonics, Vol. 16, No. 10, 92-7 (Oct., 1958).

The observed pulse height distribution from a sodium iodide crystal differs from the incident photon spectrum owing to statistical spreads, escape of photons produced by Compton scattering and escape of iodine X-rays. The matrices given enable corrections for the last two effects to be made for γ-rays up to 400 keV. R.D.Smith

535.376

3333. ON CATHODOTHERMOLUMINESCENCE.

A.Bril, H.A.Klasens and T.J.Westerhof.

Physica, Vol. 24, No. 10, 821-7 (Oct., 1958).

The light output of some phosphors was measured as a function of temperature from -180 up to 20°C. When the phosphors are m measured in a demountable tube strong maxima and minima can be found in the light output during heating up the phosphor from -180°C to room temperature. This has also been described by Gobrecht, Hahn and Scheffler who called this effect the cathodothermoluminescence. A series of sealed and thoroughly outgassed tubes was made, no indication of strong maxima and minima was found. It is concluded that cathodothermoluminescence does not seem to be a bulk property of the phosphors, but that it is more likely to be connected with gas adsorption on the phosphors.

535.376

3334. ON THE PHASE POSITION OF THE SUBSIDIARY MAXIMA OF THE LIGHT WAVES IN ELECTROLUMINESCENCE.

D.Hahn and F.W.Seemann.

Z. Naturforsch., Vol. 13a, No. 4, 349-50 (April, 1958). In German.

Curves of light waves of ZnS : Cu,Cl excited at 150 V and 5 kc/s seem to show a positive phase shift of the subsidiary peak by about a quarter wavelength if the temperature is raised from -86° to -78°C. If the peak occurring near the zero of the exciting field is considered to be the subsidiary peak, regardless of its relative size, then its phase shift is backwards in time and much smaller for the given temperature change. The temperature dependence is discussed with respect to the polarization fields in the crystal. S.T.Henderson

535.376

3335. PARTICLE SIZE EFFECTS AND THE DISTRIBUTION OF BARRIERS IN ELECTROLUMINESCENT ZINC SULFIDE PHOSPHORS.

P.Goldberg.

J. Electrochem. Soc., Vol. 106, No. 1, 34-8 (Jan., 1959).

The particle size of electroluminescent phosphors is found to be a significant factor in empirical equations describing brightness—voltage relationships. These observations can be understood by considering the following factors: (a) number and distribution of barriers in a single particle, (b) division among the barriers of the voltage drop per particle, and (c) dependence on the particle size of the voltage drop per particle. Equations are derived which permit a comparison of the brightness of different phosphors.

535.376

3336. MICROSCOPIC AND OSCILLOGRAPHIC INVESTIGATIONS OF THE ELECTROLUMINESCENCE OF INSULATING DIAMONDS.

E.Krautz and G.Zollfrank.

Optik, Vol. 14, No. 10, 446-57 (Oct., 1957). In German.

Diamonds were conically bored from opposite sides to admit tungsten wire electrodes into the graphited holes. The field was applied across about 0.2 mm by d.c., or a.c. at 30-1000 c/s. Planes were polished to give a view of the gap by photomicrography or by photomultiplier. Photographs are shown for excitation at fields above 10^6 V/cm, with very irregular light emission though the crystals appeared homogeneous. Light wave forms were simple with a small phase advance on the voltage wave. Brief spectral emission details are included. Type 2a diamonds were mainly used, since type 1 crystals gave only slight electroluminescence near the electrodes. It is considered that the mechanism of light production includes the recombination of electrons and holes.

S.T.Henderson

535.377

3337. THERMOLUMINESCENT PROPERTIES OF CALCITE.

W.L.Medlin.

J. chem. Phys., Vol. 30, No. 2, 451-8 (Feb., 1959).

The effects on thermoluminescent properties of adding certain impurities to calcite were investigated. The impurities were added as coprecipitants and their concentrations in the solid were determined by colorimetric techniques. Each of the ions which ordinarily function as activators was added but only Mn^{++} and Pb^{++} were found to be activators in calcite. Mn^{++} is responsible for two prominent peaks in the glow curve at 350 and 470°K which coincide with two of the three prominent peaks commonly found in natural samples. Pb^{++} produces two peaks of lower intensity at 300 and 410°K. Fe^{+++}, Co^{++}, and Ni^{++} quench the Mn^{++} and Pb^{++} luminescence and Co^{++} or Ni^{++} in the presence of Mn^{++} results in a 600°K peak in the glow curve which coincides with the third peak generally found in natural samples. The results for efficiency of luminescence as a function of activator concentration for the Mn^{++}, Pb^{++} and Mn—Co and Mn—Ni glow peaks are presented and discussed.

535.377

3338. THERMOLUMINESCENCE SPECTRA OF X-RAY COLORED KCl CRYSTALS.

A.Halperin and N.Kristianpoller.

J. Opt. Soc. Amer., Vol. 48, No. 12, 996-1000 (Dec., 1958).

Thermoluminescence spectra of X-ray coloured KCl crystals were recorded, using a liquid-air cooled photomultiplier as detector. Glow peaks are shown to appear in pairs — a violet one (0.395μ) and a blue one (at $0.44\ \mu$) — repeated several times throughout the temperature range of 90-550°K. The phosphorence at 90°K was found to be composed of three bands (at 0.51, 0.395, and about 0.28-$0.35\ \mu$). The $0.51\ \mu$ band shows two glow bursts on warming the crystal. The half-intensity breadth of the violet band (and probably also of the 0.44 and $0.51\ \mu$ bands) was found to equal that of the F band, this to include also the temperature broadening. It is suggested that the thermoluminescence arises from transitions involved in the recombination of free holes and F electrons.

535.39 : 539.234

3339. OPTICAL CONSTANTS OF EVAPORATED SELENIUM FILMS BY SUCCESSIVE APPROXIMATIONS.

W.F.Koehler, F.K.Odencrantz and W.C.White.

J. Opt. Soc. Amer., Vol. 49, No. 2, 109-115 (Feb., 1959).

Experimental values of the refractive index and the absorption constant in the wavelength range 0.24 to 2.5 microns are reported for evaporated films of selenium. Methods of successive approximation were used to obtain an average precision of ±0.003 in the nonabsorbing region and ±0.005 in the absorbing region. Electron microscope and electron diffraction techniques indicate that the selenium films were amorphous and nonporous.

535.393

3340. OPTICAL CONSTANTS OF EVAPORATED FILMS OF ZINC SULPHIDE AND GERMANIUM IN THE INFRA-RED.

L.Huldt and T.Staflin.

Optica Acta, Vol. 6, No. 1, 27-36 (Jan., 1959).

The constants of vacuum evaporated films, several microns thick, were determined by three different methods in the region 2000-10 000 cm^{-1} (5-1 μ). The refractive indices of both substances proved to be definitely higher than for the corresponding bulk material. If the films were evaporated with pure nitrogen as residual gas instead of air, the refractive index decreased considerably and reached, for ZnS, approximately the bulk value, whereas for Ge it still remained somewhat higher. The variations in the modes of determination seem to exclude the observed anomalies being due to complexity of the film structure.

535.394

3341. TOTAL REFLECTION FILTER WITH MULTIPLE REFLECTION.

H.Böhme.

Optik, Vol. 15, No. 7, 444-7 (July, 1958). In German.

The principle of the filter is that of spectral separation by total reflection. With 4 reflections from a silica—benzene boundary long waves are removed from the reflected beam; the cut-off wavelength is sharp and may be varied from 3000 to 6000 A by varying the angle of incidence. G.F.Lothian

535.411

3342. A CALIBRATION APPARATUS FOR A FIRE-DAMP INTERFEROMETER.

L.Grupinski.

Optik, Vol. 15, No. 8, 471-3 (Aug., 1958). In German.

A brief description of a transportable calibrator, i.e. a method of producing gas mixtures of known concentration. J.M.Hough

535.411 : 535.247.4

PHOTO-MULTIPLIER CELL FOR STUDYING INTERFERENCE FRINGES. See Abstr. 3252

535.412

3343. NOTE ON INTERFERENCE FRINGES FROM THIN WINDOWS.

S.Teitler and N.Ginsburg.

J. Opt. Soc. Amer., Vol. 49, No. 3, 230-1 (March, 1959).

The transmittance of a liquid sample interposed in a beam at normal incidence, between windows of equal thickness which produce interference fringes, is related to the values of the experimental transmittance measured at the interference maxima and minima.

535.417

3344. GAS ANALYSIS BY OPTICAL INTERFEROMETRY.

D.N.Hanson and A.Maimoni.

Analyt. Chem., Vol. 31, No. 1, 77-82 (Jan., 1959).

The theory and experimental techniques used for analysing mixtures of hydrogen—nitrogen and deuterium—nitrogen over the entire range of compositions are given. The optical interferometer is a reliable gas analytical tool capable of yielding accurate results in binary mixtures, and the deviations from linearity of the data for index of refraction v. composition can be adequately explained from molar refraction theory and the predicted deviations from ideal gas mixing behaviour. The index of refraction for deuterium for white light is slightly smaller than that of hydrogen: 1.80×10^{-6}.

535.417 : 531.715

3345. OBTAINING LOW ORDERS OF INTERFERENCE IN MEASURING FILM THICKNESSES BY MULTIPLE BEAM INTERFEROMETRY.

G.D.Scott.

J. Opt. Soc. Amer., Vol. 48, No. 11, 858 (Nov., 1958).

In multiple-beam interferometry as used for the measurement of the thickness of thin films it is desirable to use low orders by bringing the surfaces very close together. A holder is described for mounting on a microscope stage which permits easy manipulation for this purpose. S.Tolansky

535.417 : 535.345

3346. DESIGN OF MULTILAYER FILTERS BY SUCCESSIVE APPROXIMATIONS.

P.Baumeister.

J. Opt. Soc. Amer., Vol. 48, No. 12, 955-8 (Dec., 1958).

A relaxation method is used to adjust the thicknesses of the films of a multilayer in order to alter its transmission characteristics in a limited spectral region. This method is used to modify the spectral transmission of a short-wavelength pass multilayer and a broad-band dielectric mirror. The computations also furnish information useful in controlling the thicknesses of the layers in the fabrication of a multilayer.

535.417 : 531.715

3347. NEW GAUGE INTERFEROMETER. P.Hariharan and D.Sen.
J. Opt. Soc. Amer., Vol. 49, No. 3, 232-4 (March, 1959).

An interferometer for the absolute measurement of the length of end standards is described in which the optical path difference introduced between the interfering beams is only half the length of the gauge. This permits the direct measurement of gauge blocks up to 1 m long with the isotope sources currently available. Other advantages of the instrument are its relatively compact layout and simplicity of operation.

535.417

3348. EVALUATION OF TRANSVERSE ABERRATIONS WITH THE DUPLIGRAM METHOD. R.Schalge.
Optik, Vol. 15, No. 2-3, 138-44 (Feb.-March, 1958). In German.

The use of the dupligram method for tracing transverse aberrations from interference patterns is discussed. The method is applied to lens testing and an example is analysed.

S.Tolansky

535.417

3349. EXPERIMENTAL AND THEORETICAL RESEARCHES ON THE GENERAL USE OF THE FABRY-PEROT SPECTROMETER FOR VARIOUS SPECTROSCOPIC APPLICATIONS. R.Chabbal.
Rev. Opt., Vol. 37, No. 2, 49-103 (Feb.); No. 7, 336-70 (July, 1958). In French.

The use of the Fabry-Perot for examining wide spectral ranges is considered in detail. Luminosity and elimination of parasitic radiation are treated in particular. A discussion is included of the importance of reflection and absorption coefficients, surface quality and finite apertures of the interferometer, and various rules are derived. Monochromatic systems, crossing with spectrographs and the use of chains of etalons are discussed in detail. The effects of using monochromatic filters are investigated theoretically and transmission factors and width of transmissions are derived. It is considered that the best arrangement is to put in series a grating and two Fabry-Perot interferometers. It is shown that a Fabry-Perot correctly used has 100 times the luminosity of a grating with the same dimensions. Instruments are made according to predictions and especially one is designed for the infrared. High light-gathering powers are secured.

S.Tolansky

535.417 : 531.715

3350. ON THE IMPROVEMENT OF THE PRECISION OF MICRO-INTERFEROMETRY. INVESTIGATIONS CONCERNING INTERFERENCE SPHEROMETRY. R.Landwehr.
Z. InstrumKde, Vol. 66, No. 7, 134-8 (Aug., 1958). In German.

A geometrical analytical examination concerning the calculation of corrections in exact two-beam interferometry. The displacements arising both from the small angle of inclination between the surfaces and also from the finite angles of the incident cone of light are computed. Tables of corrections are given for numerical apertures up to 0.65. The application of these computations to the possibility of accurate interference spherometry is discussed.

S.Tolansky

535.417 : 535.33.07

SPECTROPHOTOMETRY WITH INTERFERENCE FILTERS. See Abstr. 3270

535.417 : 531.717.7

PRECISION MEASUREMENTS WITH THE RING SPHEROMETER. See Abstr. 3176

535.42

3351. EXPERIMENTAL STUDY OF THE DIFFRACTION PATTERNS PRODUCED BY MIRRORS WITH IMPERFECT SURFACES. S.Nawata.
J. Opt. Soc. Amer., Vol. 49, No. 3, 298-303 (March, 1959).

The diffraction patterns produced by mirrors that are not flat were observed at wavelengths 0.546 μ and 2.05 μ, by means of an Ebert spectrometer optical arrangement with the imperfect mirrors in the place of the grating. It is shown that they have satellites caused by the periodic or random errors, much like Rowland ghosts of gratings. The observed diffraction intensity curves are compared with calculated curves.

535.42 : 534.321.9

3352. DIFFRACTION OF LIGHT BY ULTRASONIC WAVES — OBLIQUE INCIDENCE AND SOUND INTENSITY.
S.Parthasarathy and C.B.Tipnis.
Nature (London), Vol. 182, 1795-6 (Dec. 27, 1958).

Previous experimental work (Abstr. 1338/1959) was extended by increasing the intensity. None of the existing theories explain the observations.

H.D.Parbrook

535.42 : 534.213

DIFFRACTION OF LIGHT BY ULTRASONIC WAVES IN LIQUIDS. See Abstr. 3223

535.42

3353. DIFFRACTION BY AN OPAQUE STRIP. R.S.Longhurst.
Proc. Phys. Soc., Vol. 72, Pt 5, 901-5 (Nov., 1958).

Measurements of the visibility of fringes by Marković (Abstr. 1631/1958) are compared with the theories of Rubinowicz (Abstr. 160/1918) and Sommerfeld (Optics, New York; Academic Press, 1954); good agreement with Sommerfeld's theory is found.

A.R.Stokes

535.42

3354. APPLICATION OF THE MODIFIED WATSON TRANSFORMATION TO THE GREEN'S DYAD FOR THE DIFFRACTION BY A SPHERE. P.Beckmann.
Z. Naturforsch., Vol. 12a, No. 12, 960-7 (1957). In German.

When applied to the series of cylindrical functions in the Green's dyad, the Watson transformation yields complex integrals in the index plane. The geometrical-optical elements are obtained asymptotically as contributions of saddle points. The diffracted waves are represented by sums of residues in the form of "creeping" waves.

F.Lachman

535.421

3355. INTERFEROMETRICALLY CONTROLLED RULING OF TEN-INCH DIFFRACTION GRATINGS.
G.R.Harrison, N.Sturgis, S.P.Davis and Y.Yamada.
J. Opt. Soc. Amer., Vol. 49, No. 3, 205-11 (March, 1959).

Seven plane gratings of high quality having ruled widths of more than 10 in. have now been produced on the M.I.T. servo-controlled ruling engine, monitored with interference fringes. Resolving powers closely approaching the theoretical 900 000 in the 12th order green, and above 1 200 000 in the 26th order of 2537 A, have been obtained with several gratings in a 40 ft spectrograph having 10 in. concave mirrors. The wave fronts produced by the gratings, ruled with 7442 grooves per in. in some cases and 300 grooves per mm in others, have been studied with a large Michelson—Twyman interferometer at angles of incidence and reflection having sums up to 150°, in accordance with the method described by Stroke. Ghost and satellite intensities in all orders, as well as the blaze properties of the gratings, have been measured on a 5 m Littrow spectrograph with 8 in. lens. Rowland ghosts in several cases are found to be well below 0.1% in the 12th order green, and below one part in 100 000 at the angles at which ghost intensities are usually measured for purposes of comparison. In the better gratings satellite intensities total less than 1%, with no single satellite stronger than 0.3%. The stronger satellites reported in the previous 8 in. gratings were found to originate from tilting of the interferometer mirrors and the grating blank arising from variations along the ways. Since the gratings have 50 in.^{2} of rules area and are well blazed they are extremely fast, 20 sec being adequate to give a satisfactory exposure to ordinary sources at dispersion of 12 mm per A. The blaze angle was varied from one grating to the next. Some of the gratings concentrate more than 50% of the incident green light in a single high order.

535.421

3356. CONTRIBUTIONS TO THE PRODUCTION OF DIFFRACTION GRATINGS BY PHOTOGRAPHIC REPRODUCTION OF INTERFERENCE FRINGES. R.Ritschl and S.Polze.
Optik, Vol. 15, No. 2-3, 127-31 (Feb.-March, 1958). In German.

The conditions required for the successful production of the gratings and the attempts made by previous investigators are briefly discussed. Some preliminary experiments using a Lloyd's mirror system are described.

S.Weintroub

535.43 : 539.2

3357. A SENSITIVE METHOD FOR MEASURING OPTICAL SCATTERING IN SILICON.
G.H.Schwuttke, O.A.Weinreich and P.H.Keck.
J. Electrochem. Soc., Vol. 105, No. 12, 706-9 (Dec., 1958).

An instrument was developed for the observation of optical scattering in silicon and in intermetallic compounds. It is considered as a supplementary tool suitable for studying crystal imperfections in conjunction with other optical methods. Scattering patterns of heat-treated, crucible-grown silicon crystals are discussed as examples. The observations are in complete agreement with previously published results obtained by several other investigators on the clustering of oxygen in silicon caused by heat treatment.

535.514.2

3358. PILE-OF-PLATES POLARIZERS FOR THE INFRARED: IMPROVEMENT IN ANALYSIS AND DESIGN.

G.R.Bird and W.A.Shurcliff.

J. Opt. Soc. Amer., Vol. 49, No. 3, 235-7 (March. 1959).

The history of the transmission-type pile-of-plates polarizer has been dominated by two equations which make different assumptions as to the fate of the unwanted, multiply-reflected rays. Both equations assume that the polarizer consists of parallel-sided plates mounted parallel to one another and inserted in the beam at Brewster's angle. The present article shows that better results are obtained if the plates are slightly wedge-shaped, are mounted in "fanned" manner, and are mounted at an angle slightly exceeding Brewster's angle. A performance better than that implied by either equation is achievable.

535.516

3359. DEMONSTRATION OF THE INTERSECTION CURVES IN THE TOTAL REFLECTION OF CALCITE. C.v.Fragstein.

Optik, Vol. 14, No. 11, 519-24 (Nov., 1957). In German.

It is shown that illumination of calcite cut parallel to the optic axis produces two intersecting curves, a circle and an ellipse below the critical angle for total internal reflection. A geometrical analysis is carried out and it is shown that the ordinary and extraordinary refractive indices can be obtained from the ellipse axes. S.Tolansky

535.557

3360. EFFECT OF FORM IN THE FLOW BIREFRINGENCE OF POLYMER SOLUTIONS.

V.N.Tsvetkov, É.V.Frisman, O.B.Ptitsȳn and S.Ya.Kotlyar.

Zh. tekh. Fiz., Vol. 28, No. 7, 1428-36 (1958). In Russian.

Presents a new theory of this effect, based on the previously suggested model of macromolecules in solution, construed as colloidal particles saturated with the solvent. It it shown that, for small velocity gradients, the effect of the form is proportional to the gradient, whereas in the case of large gradients it tends to a limit. It is claimed that the theory accurately describes experimental data, in particular the previously established relationship between the sign of birefringence of the polystyrene solution in dioxane and the velocity gradient. F.Lachman

535.681

3361. ON THE COLOUR MEASUREMENT OF DAYLIGHT FLUORESCENT MATERIALS. B.Hisdal.

Optica Acta, Vol. 3, No. 3, 139-44 (Sept., 1956).

Standard C.I.E. sources B and C are not suitable as illuminants for colour measurement of daylight fluorescent materials because of their low ultraviolet energy content. An arrangement is described where an increase in ultraviolet energy is obtained by the use of an ultraviolet source in addition to source B or C. This source consists of a tungsten lamp operated at a colour temperature of 2854°K and a filter which transmits only below 4000 A. Two examples of ultraviolet energy distributions obtainable have been calculated and measured. These examples are so chosen that the energy distributions above 3900 A are the same as source B or C. Daylight fluorescent samples have been measured and the colour computed using the selected ordinate method.

535.7

PHYSIOLOGICAL OPTICS. VISION. See also the Section entitled "BIOPHYSICS. PHYSIOLOGICAL PHYSICS".

535.81

3362. TESTING LOW-PRECISION OPTICS. E.Speyer.

J. Opt. Soc. Amer., Vol. 48, No. 12, 953-4 (Dec., 1958).

Bulk collectors of radiant energy (as distinguished from image-forming optical systems) can be tested for concentration of energy, uniformity of the concentration, and geometrical figure by comparing photographic transparencies exposed in the concentration region with similar transparencies exposed without using the concentrator.

535.81

3363. ON A LIGHT-POINTER ARRANGEMENT FOR NULL INSTRUMENTS. H.Haas.

Optik, Vol. 15, No. 2-3, 135-7 (Feb.-March, 1958). In German.

The use of a porro-prism permits the light beam reflected from a mirror to be split into two beams which deflect in opposite directions for a mirror rotation. Thus the null position is shown as the only position for which there is a single beam. J.M.Hough

535.822.1

3364. CONCERNING DIFFERENTIAL INTERFEROMETRY, ITS ATTAINMENT AND COMPARISON WITH INTERFERENCE FRINGE OF EQUAL THICKNESS. W.Gärtner.

Optik, Vol. 15, No. 5, 281-8 (May, 1958). In German.

Two microscope attachments for producing contrast by differential interferometry are described. One employs two Wollaston prisms and polarizers to produce a double image. The other uses reflection from the two surfaces of a thin wedge. Both attachments are equally useful for transparent or opaque specimens and replace the eyepiece of the ordinary microscope. Different lateral separations of the double image were investigated with a variable wedge. Separations from two to five times the limit of resolution, depending on the object, were found useful. With much larger separations fringes of equal thickness can be obtained with a suitable object ove part of the field of view. These fringes enable quantitative measurements to be made, but the differential interferometry gives better visibility of fine detail and a useful qualitative picture of the whole field of view. H.Mykura

535.822.17

3365. MICROINTERFEROMETRIC MEASUREMENTS OF SMALL PHASE OBJECTS (BLOOD CORPUSCLES).

U.Amelung and A.Lohmann.

Optik, Vol. 15, No. 5, 289-92 (May, 1958). In German.

An interference microscope using a Wollaston prism to give a double image of variable separation and containing a half shadow plate is described. Phase determinations accurate to $\lambda/300$ can be made on cells in isotonic solution with specimen sizes down to $1\ \mu$ in diameter. The measurements of Barer (Abstr. 4286/1952) on the albumen content of red blood cells have been repeated and verified. H.Mykura

535.822.17

3366. PHASE-CONTRAST FLUORESCENCE MICROSCOPY.

H.Haselmann and D.Wittekind.

Z. wiss. Mikr., Vol. 63, No. 4, 216-26 (March, 1957). In German.

The applications of phase-contrast and fluorescence microscopy as separate techniques are described. An arrangement combining them is shown and its application to cytology stressed. Typical examples are given. A large number of references are included. R.W.Fish

535.823.51 : 539.1.07

3367. MICROSCOPE MECHANICAL OBJECT STAGE FOR THE STUDY OF THE TRACKS OF CHARGED PARTICLES IN PHOTOGRAPHIC EMULSIONS OR OTHER OBJECTS IN TRANSPARENT MEDIA. H.Slätis.

Rev. sci. Instrum., Vol. 29, No. 11, 968-70 (Nov., 1958).

In addition to the usual arrangements for measurements of the x and y coordinates for nuclear tracks in photographic emulsions, the stage is rotatable about the optical axis of the microscope as well as about an axis perpendicular to the optical axis. The angles of rotation can be read off scales. Through these arrangements and by the use of an eyepiece micrometer the orientation and the length of nuclear tracks can be measured directly.

535.824.1

3368. EYEPIECES. IV. ON THE CALCULATION OF COMPENSATING HUYGENS EYEPIECES. A.Biot.

Ann. Soc. Sci. Bruxelles I, Vol. 72, No. 3, 103-6 (1958). In French.

For Pt III, see Abstr. 239 (1958). Formulae are given for the powers and separations of the (thin) components in terms of given total power, pupil positions and chromatic over-correction. A numerical example is given. W.T.Welford

535.825

3369. MICROFURNACE FOR THERMAL MICROSCOPY AND STUDIES AT HIGH TEMPERATURES. W.A.Lambertson and G.Lewis.

J. Electrochem. Soc., Vol. 106, No. 2, 124-6 (Feb., 1959).

A small laboratory furnace is described for use in high-temperature microscopy and for determining chemical compatibility, wetting, sintering, and temperatures of apparent melting up to 3000°C (5433°F). The furnace shell is a water-cooled, 5 in. copper tee and is of such construction as to afford a controlled atmosphere. Water-cooled electrodes are designed to hold refractory metal strip heaters (either plain or with a wedge for better black body conditions) or special-machined graphite heaters. Stepless power input is provided by variac-controlled, saturable core reactor.

535.88 : 515

70. OPTICAL TRANSFORMATION OF THE GENERAL QUAD-LATERAL INTO ANOTHER. W.Hanke.
tik, Vol. 15, No. 4, 219-24 (April, 1958). In German.

See Abstr. 7812 (1955). A system of relations is derived for e determination of the image quadrilateral given the original adrilateral together with its position relative to the objective.
S.Weintroub

535.89

71. RADIO LUMINESCENCE AS CONSTANT-INTENSITY LIGHT URCE. W.Hanle and I.Kügler.
tica Acta, Vol. 3, No. 3, 131-8 (Sept., 1956). In German.

A study is made of the problem of establishing sources of light the combination of a radioactive material with luminescent materls. The principal difficulty arises from the gradual destruction of e luminescent material by the high energy of the radiation. Comnations of radioactive and luminescent materials are given which ake possible the establishment of sources of an intensity which is nstant though rather weak.

535.89 : 522.612

LIGHT SOURCES FOR STELLAR SPECTROPHOTOMETRY.
e Abstr. 3035

535.892 : 535.4

372. MICROCOMPARATOR ILLUMINATION SYSTEM FOR MPROVED RESOLUTION OF RAYLEIGH DIFFUSIOMETER IAGRAMS. J.L.Oncley, M.Ludwig and T.E.Thompson.
ev. sci. Instrum., Vol. 29, No. 11, 985-7 (Nov., 1958).

A microcomparator illumination system is described which ermits Rayleigh diffusiometer diagrams to be measured with increased precision. Measurement is based on the use of diffraction atterns generated by the Rayleigh diagram when this diagram is luminated with point-source, divergent, monochromatic light. nder favourable conditions a two- to fivefold increase in precision f measurement may be obtained with this illumination system.

HEAT

536.2

373. THE TRUE HEAT EQUATION. P.Vernotte.
.R. Acad. Sci. (Paris), Vol. 247, No. 23, 2103-5 (Dec. 10, 1958).
n French.

See Abstr. 1356 (1959). The author acknowledges the prior laims of others, but discusses in what way his consideration differs rom the statistical and is original.
S.Weintroub

536.2

374. A HEAT CONDUCTION PROBLEM INVOLVING A SPECI-IED MOVING BOUNDARY. R.E.Gibson.
uart. appl. Math., Vol. 16, No. 4, 426-30 (Jan., 1959).

Mathematical. The temperature equation

$$\frac{1}{k}\frac{\partial v}{\partial t} = \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial v}{\partial r}\right) + \frac{A(t)}{K},$$

$) \leq r \leq R(t)$. where the constants k and K are respectively the hermal diffusivity and conductivity, is solved subject to certain onditions and for various values of the rate of movement R(t) of he boundary.
S.Weintroub

536.2 : 539.17

HEAT TRANSFER PROBLEMS IN REACTOR TECHNOLOGY.
See Abstr. 2853

536.21 : 536.48

THE THERMAL CONDUCTIVITY OF CONDENSED HELIUM.
ee Abstr. 2269

536.21 : 531.258

TWO-DIMENSIONAL THERMAL STRESSES DUE TO STEADY HEAT FLOW IN A SEMI-INFINITE AEOLOTROPIC PLATE.
See Abstr. 3171

536.212.3

3375. THERMAL CONDUCTIVITY OF UO_2. R.Scott.
Atomic Energy Res. Establ. (Harwell) Rep. M/R2526, 7 pp. (1958).

An experimental measurement of the thermal conductivity of stoichiometric UO_2 of 96% theoretical density, over the range 300°-1150°C, is described. The results are considered in conjunction with previous measurements and it is concluded that the expression,

$$K = \frac{10}{T + 400}\ \text{cal/(cm sec deg C)},$$

where T is the temperature in deg C, represents the thermal conductivity of UO_2 of theoretical density. Irradiation data for UO_2 are not inconsistent with the value

$$K = \frac{8D}{T + 400}.$$

The behaviour of UO_2 cylindrical rods under thermal stress is considered and it is shown that a temperature difference in excess of 150 deg C between the surface and axis will cause cracking.

536.212.3

3376. AN INVESTIGATION OF THE CORRECTION FOR PERIPHERAL HEAT-LOSS FROM THICK SAMPLES IN LEES AND CHORLTON'S DISC METHOD OF DETERMINING THERMAL CONDUCTIVITY. A.K.M.Ahsanullah and M.M.Qurashi.
Pakistan J. Sci. Res., Vol. 1, No. 2, 136-45 (April, 1958).

When the peripheral loss is less than the heat flowing across the sample face, the heat flow may be considered as essentially rectilinear conduction with the lines of flow parallel to the disk axis, except near to the periphery where they are inclined to the axis with an inclination which is a function of their distance from the axis. An expression is derived for the thermal conductivity K in terms of the conductivity assuming no peripheral loss and the thickness d of the sample. For small d, the change in K is proportional to d, while for large d, K depends more nearly on d^2. The results of an experimental test made on disks of an insulating material of thicknesses from $\frac{1}{2}$ to 2 in. are given.
S.Weintroub

536.212.3

3377. AN APPARATUS FOR THE MEASUREMENT OF THE THERMAL CONDUCTIVITY OF INSULATING MATERIALS OF CYLINDRICAL SHAPE. A.Nuvoli.
Ricerca sci., Vol. 28, No. 10, 2095-101 (Oct., 1958). In Italian.

An industrial form of apparatus of tubular shape, using radial flow and provided with guard devices. The conductivity for temperatures up to approximately 500°C may be determined from a single or limited number of tests. Data obtained for standardization of the method are given.
S.Weintroub

536.22 : 537.29

3378. THE INFLUENCE OF ELECTRIC FIELDS ON THE HEAT TRANSFER IN LIQUIDS. H.Senftleben and R.Lange-Hahn.
Z. Naturforsch., Vol. 13a, No. 2, 99-105 (Feb., 1958). In German.

Results of an experimental study, using the Schleiermacher hot-wire method, on the liquids carbon tetrachloride, cyclohexane, toluene, chloroform and ether, are given. The dependence of the heat transfer on the potential and temperature gradients was investigated. The interpretation is similar to that given for gases (see Abstr. 4452/1954) and the form of the equation $Nu_{el} = f(Gr, Pr, V)$ valid for all gases and liquids is derived, where Nu, Gr, Pr are the Nusselt, Grashof and Prandl numbers and V is a new dimensionless number representing the action of the electric field. The experimental values for several gases and liquids are shown to be in agreement with the theoretical relation.
S.Weintroub

536.223

3379. THE THERMAL CONDUCTIVITY OF AQUEOUS THORIA SUSPENSIONS. F.A.Johnson.
Atomic Energy Res. Establ. (Harwell) Rep. R/R2578, 18 pp. (1958).

Experiments were carried out in the range 0-100°C and at concentrations between 0 and 20% by volume. Three other systems, of similar concentration, were also investigated at 30°C. On the basis of these measurements and on similar work by other investigators, expressions are suggested for the calculation of slurry conductivity from the conductivities of the constituent substances together with the volume concentration of solids.

536.23

3380. THERMAL CONDUCTIVITY OF NITROGEN BETWEEN 75° AND 700°C AND UP TO 1000 TO 1600 ATMOSPHERES.
P.Johannin.
J. Rech. Cent. Nat. Rech. Sci., No. 43, 116-55 (June, 1958).
In French.

After a brief review of the theory and the various methods of measurement of the thermal conductivity of gases, the apparatus used is described in detail. The conductivity cell consists of two vertical coaxial cylinders, the inner cylinder 88 mm long and 13.1 mm diameter and heated internally, and the outer cylinder

150 mm long, 20 mm external diameter and 13.5 mm internal diameter. Cylinder gas, compressed and filtered, was used. The pressure was measured by three precision Bourdon-type gauges; the first (covering 1600-400 atm) and second (400-100 atm) were calibrated by means of a pressure balance; the third covered pressures near to 1 atm. The cell was calibrated by treating it as an electrical condenser. The results, tabulated and shown graphically, are compared with those of previous investigators.

S.Weintroub

536.241

3381. THERMAL CONTACT AT LOW TEMPERATURES.

R.Berman and C.F.Mate.

Nature (London), Vol. 182, 1661-3 (Dec. 13, 1958).

The contact apparatus, shown diagrammatically, differs from that described previously by Berman (Abstr. 3674/1956) mainly in the methods of application and measurement of the load. The variation of the thermal conductance Q with load W (up to about 200 lb) was measured for a Cu—Cu contact at 18 and 4.2°K and a Cu—diamond contact at 4.2 and 2.7°K. The results, together with the variation of Q with temperature at W = 100 lb for Au—Au, Cu—Cu, Cu—diamond and sapphire—sapphire contacts, are shown graphically and discussed. At helium temperatures the value of Q for the Au contact was 25 times that for the Cu contact.

S.Weintroub

536.25 : 538.6

3382. FREE CONVECTION OF HEAT IN MERCURY IN A CLOSED CIRCULAR TUBE IN A TRANSVERSE MAGNETIC FIELD.

A.G.Smirnov.

Zh. tekh. Fiz., Vol. 28, No. 7, 1549-55 (1958). In Russian.

Liquid Hg was enclosed in a glass tube inclined at 10° from vertical. Heat was transmitted from the upper to the lower end, and the effect of a transverse magnetic field H = 70-7000 G on the free heat convection was studied for the case (A) when the direction of H was perpendicular to the plane S separating the upward and downward convection currents, and for the case (B) when the direction of H was parallel to S. In weak H (< 110 G in case A, and < 300 G in case B) the temperature gradient varied as H^2, in strong H it increased linearly until a certain critical value — dependent on the heat input — was reached, when further increase of H did not cause any variation of the temp. gradient. When this stage is reached the laminar convection is entirely suppressed. Thus, the application of a sufficiently strong transverse H to the portion of the tube characterized by laminar convection produces a "retarding" effect both in the hydrodynamic and in the thermal sense since the flow of the liquid in this portion of the tube practically ceases and the total flow in the tube is decreased. Application of the magnetic field to the portion of the tube in which heat is transferred by conduction has no effect on the temperature distribution neither in this nor in other portions of the tube.

M.H.Sloboda

536.33.08

3383. SENSITIVE SEMICONDUCTOR-DETECTOR FOR INFRARED RADIATION.

M.Varićak.

Amer. J. Phys., Vol. 26, No. 8, 561-2 (Nov., 1958).

It is the purpose of this note to describe a simple thermistor-bolometer, suitable for demonstration experiments in infrared radiation and the radiation emissivity of various surfaces.

536.33.08 : 535.23.08

3384. THE NATURAL LIMITS OF SENSITIVITY OF METAL BOLOMETERS.

G.Barth.

Optik, Vol. 15, No. 11, 694-709 (Nov., 1958). In German.

Using the usual bridge arrangement, the noise equivalent power of a bolometer is calculated for optimum sensitivity conditions. Similar conditions are examined with modulated radiation. From the results, the best operating conditions for a metal bolometer are determined.

R.W.Fish

536.413

3385. THERMAL EXPANSION OF SOME CRYSTALS WITH THE DIAMOND STRUCTURE.

D.F.Gibbons.

Phys. Rev., Vol. 112, No. 1, 136-40 (Oct. 1, 1958).

The linear coefficient of thermal expansion of silicon, germanium, and indium antimonide was measured in the range 4.2°K-300°K using an interferometric method. In the cases of silicon and germanium, these values are used to calculate the variation in Grüneisen's factor γ with temperature and the result is compared with the predictions of Barron. Silicon and indium antimonide have negative values for γ at low temperatures and some of the requirements for a structure to behave in this manner are suggested, namely, fourfold coordination in the lattice, covalent bonding, and openness of structure.

536.421.1 : 536.7

3386. ON THE QUANTUM EFFECT ON MELTING.

M.Toda.

Nuovo Cimento Suppl., Vol. 9, No. 1, 39-44 (1958).

The lowering of the melting point due to (small) quantum effects is related by a thermodynamic argument to the difference in the quantum free energies of the two phases. A limit to the quantum effect is predicted, beyond which there is no melting point at low pressures (He). The relation is generalized to consider two similar molecular substances. The predicted change in melting point is in agreement with experimental values for the pairs $C^{12}H_4$, $C^{13}H_4$ and CH_4, CD_4.

P.Gray

536.422.15

3387. VAPOR PRESSURE OF NIOBIUM.

R.Speiser, P.Blackburn and H.L.Johnston.

J. Electrochem. Soc., Vol. 106, No. 1, 52-3 (Jan., 1959).

The Langmuir method was used to make the determination. An accommodation coefficient of unity was assumed. Least square treatment of the vapour pressure data yields the equation

$$\log P_{atm} = -\frac{(40,169)}{T} + 8.872$$

The heat of sublimation at absolute zero, ΔH^0_0, is 171.80 ± 0.49 and $\Delta H^0_{298.15}$ is 172.53 kcal/(g atom).

536.424.1 : 537.311.31

THE INFLUENCE OF THE MARTENSITIC TRANSFORMATION ON THE ELECTRICAL RESISTANCE OF SODIUM. See Abstr. 2310

536.424.1 : 539.2

PHASE TRANSITIONS IN $CrK(SO_4)_2.12H_2O$ AND $FeNH(SO_4)_2.12H_2O$. See Abstr. 2937

536.48 : 539.2

3388. HEAT CAPACITY OF DILUTE MAGNESIUM-ALUMINUM ALLOYS BELOW 4.2°K.

J.Rayne.

J. Phys. Chem. Solids, Vol. 7, No. 2-3, 268-74 (Nov., 1958).

Heat capacity measurements below 4.2°K were made on a series of dilute magnesium—aluminium alloys. The resulting variation of the electronic term with solute concentration suggests that a new overlap across the Brillouin zone is initiated at an electron concentration of about 2.02. The effective mass ratio of these overlap electrons is given approximately by $m^*/m = 0.6$, which figure is in reasonable agreement with theoretical estimates. No abrupt change of the Debye temperature with solute concentration is observed.

536.48

3389. RESULTS OF INVESTIGATIONS AT LOW TEMPERATURES. XVII. T^3 AND PSEUDO-T^3 REGION OF LITHIUM FLUORIDE.

K.Clusius and W.Eichenauer.

Z. Naturforsch., Vol. 11a, No. 9, 715-18 (1956). In German.

For Pt XVI see Abstr. 2840 (1956). The specific heat is measured down to 10°K in a 300 gram LiF crystal. The pseudo-T^3 in the liquid air region noted earlier (Abstr. 3131/1950) is confirmed. The proper T^3 region is reached at 18°K with a Debye Θ of 723°K. With respect to the molar heat LiF is more anomalous than other alkali halides; also in the electron distribution it shows larger deviations from isotropy than e.g. KCl or NaCl.

H.London

536.48

3390. RESULTS OF INVESTIGATIONS AT LOW TEMPERATURES. XVIII. THE ATOM AND ELECTRON HEATS OF PLATINUM BETWEEN 10° AND 273°K.

K.Clusuis, C.G.Losa and P.Franzosini.

Z. Naturforsch., Vol. 12a, No. 1, 34-8 (1957). In German.

For Pt XVII see preceding abstract. The specific heat was measured in a 205 gram Pt cylinder. A normal entropy at 25°C of 9.95 Clausius is obtained. Below 16°K the atomic heat expressed as the sum of lattice heat C_g and electronic heat C_e is $464.5(T/221)^3 + +15.8 \times 10^{-4}\, T$. Above 90°K C_g can be expressed by a Debye function with $\Theta = 238^0$ to 240°K, if one assumes $C_e = 10 \times 10^{-4}\, T$. A similar change in the coefficient of the electronic heat has been observed previously in Pd (Abstr. 3193/1947).

H.London

536.48

3391. ON THE PHASE TRANSITION AND EXCITATIONS IN LIQUID HELIUM.

G.Borelius.

Ark. Fys., Vol. 14, Paper 10, 127-32 (1958).

The energy of liquid helium can be expressed by

$$E = xE_1 + (1 - x)E_2$$

with $E_1 = 5.50 + 1.57T^2$ and $E_2 = 0.0204T^4$ J/mole. At the λ-point $x = x_\lambda = 0.907$; above the λ-point x approaches 1 within a short temperature interval; below the λ-point $x = x_\lambda(\rho_n/\rho)$, where ρ_n is the density of the normal fluid as determined by Andronikashvili. The entropy can be represented by

$$S = xS_1 + (1 - x)S_2 + \Delta S,$$

where S, S_1 and S_2 are derived thermodynamically from E, E_1 and E_2. The resulting value of the mixing entropy ΔS can be expressed fairly accurately by

$$\Delta S = -[R/(8.5 \pm 1)]x \ln x$$

This suggests that the normal fluid is composed of rotons, each of which comprises about 8-9 atoms. If a theoretical reason can be found that these rotons obey the Pauli exclusion principle, the seemingly inconceivable observation in a previous paper (Abstr. 7865/1958) that He I can be described as a condensed Fermi gas could be understood. H.London

536.48

3392. ENERGY FLUCTUATIONS IN LIQUID HELIUM AND ITS FLOW PROPERTIES. O.K.Rice.
Nuovo Cimento Suppl., Vol. 9, No. 1, 267-85 (1958).

The author submits that the energy levels of helium are not necessarily states of momentum of microphysical entities. From this point of view, various aspects are discussed of liquid helium theory, such as the mass of rotons, the forces causing the flow of the superfluid, the mechanism of energy transfer and of dissipative processes. In particular, attention is drawn to the effect of energy fluctuations which may give rise to appreciable local gradients of temperature. R.Eisenschitz

536.48

3393. QUANTIZED GROWTH OF TURBULENCE IN He II. K.Mendelssohn and W.A.Steele.
Proc. Phys. Soc., Vol. 73, Pt 1, 144-6 (Jan., 1959).

Experiments on the conduction of heat by helium II were performed with a thermally insulated tube open at the cold end to a helium bath. The temperature was measured at both ends and in the middle of the tube. At low rates of heat input the thermal resistance is virtually independent of the heat input. At some critical rate of heating the thermal resistance rises discontinuously. If the rate of heating remains fixed the growth of the thermal resistance progresses slowly and proportionally to the time. It is concluded that the state of high thermal resistance gradually fills the tube with its front moving at a constant speed. The increase in thermal resistance is considered to be associated with turbulent movement of the superfluid component. R.Eisenschitz

536.48

3394. ON THE HELIUM FILM IN NON-STATIC CONDITIONS. S.Franchetti.
Nuovo Cimento, Vol. 10, No. 4, 622-34 (Nov. 16, 1958).

The flowing film is regarded as a system in thermal equilibrium so that it is accessible to thermodynamic theory. An expression for the chemical potential is obtained which depends upon the rate of film flow. By setting the chemical potential of the film and the bulk liquid equal to each other a quantitative relation is obtained between rate of flow and thickness of the film. The method is generalized to include films the temperature of which is non-uniform. By postulating that the chemical potential should be uniform a thermomechanical effect of film flow is deduced. R.Eisenschitz

536.48

3395. RECENT EXPERIMENTS ON SUPERFLUIDITY. K.Mendelssohn.
Nuovo Cimento Suppl., Vol. 9, No. 1, 228-33 (1958).

Thermal conductivity measurements on He II in capillaries of diameter $d = 2a = 10^{-2}$ cm, at extremely low heat current $\dot{Q}$, indicate a heat transport mechanism entirely controlled by the viscosity of the normal fluid ($\Delta T/\dot{Q}$ = constant) and absence of mutual friction between the two fluids. Increase of $\dot{Q}$ to larger values caused a sudden rise of $\Delta T/\dot{Q}$, followed by a gradual non-linear increase with increasing $\dot{Q}$. This extrapolates back to the same value of $\Delta T/\dot{Q}$ at $\dot{Q} = 0$, as in the case without mutual friction. On reducing $\dot{Q}$, $\Delta T/\dot{Q}$ would decrease gradually and the transition to frictionless flow would take place at a much lower value of $\dot{Q}$. Reducing $\dot{Q}$ to zero and increasing again would not lead back to the original course of events; instead the transition occurs close to the value of $\dot{Q}$ at which the mutual friction disappeared on falling $\dot{Q}$. Times of the order of an hour had to elapse, before the original hysteresis curve could be reproduced. Combining the present data with those of Vinen on second-sound attenuation in the presence of heat flow (Abstr. 6120/57) and with results on the critical velocity in films and narrow slits, it appears that the critical velocity is proportional to $d^{-1/2}$. H.London

536.48 : 539.21

SUPERFLUID HELIUM INSIDE NEUTRON-IRRADIATED SILICON. See Abstr. 2942

536.48

3396. INTERACTIONS BETWEEN FIRST AND SECOND SOUND IN LIQUID HELIUM. A.J.Dessler.
Phys. of Fluids, Vol. 2, No. 1, 5-7 (Jan.-Feb., 1959).

The reflection coefficient for a small-amplitude second sound wave reflected by a large-amplitude first sound wave front is derived. This type of reflection is unique in that the discontinuity (the first sound wave) travels faster than the wave being reflected. Hence, the discontinuity can overtake the second sound wave from behind. It is shown that the principal term in the reflection coefficient is due to the particle velocity associated with a pressure wave. This reflection coefficient is positive when the discontinuity overtakes the second sound wave from behind and negative when the discontinuity and the second sound wave are approaching one another head-on. The reflection coefficient for a small-amplitude first sound wave reflected by a large-amplitude second sound wave front is also derived.

536.483 : 539.17

A CRYOSTAT FOR REACTOR IRRADIATIONS IN LIQUID NITROGEN. See Abstr. 2849

536.5 : 538.55 : 621.317.39

3397. THE TEMPERATURE OF HORIZONTAL WIRES HEATED BY ALTERNATING CURRENT. G.A.Ostroumov.
Zh. tekh. Fiz., Vol. 28, No. 7, 1575-84 (1958). In Russian.

Measurements have been made of the temperature variation of platinum wires, 0.5 mm dia. and length 50 mm immersed in different fluids and heated by an alternating current at different frequencies. The measuring circuit is described, together with the technique for determining the temperature from the oscilloscope record. The change in temperature of the wire lags behind the change in current, so the temperature may thus be divided into an active and a reactive ($\frac{1}{4}$ period out of phase) component. These are measured for water and ethyl alcohol for frequencies 19 to 210 c/s. In a second series of experiments, lower modulation frequencies are used, and the temperature components measured for a wider range of fluids. The differences between the results with sinusoidal current variation and that obtained by frequency modulation are discussed. These results have some application to the convective heat loss from periodically heated, horizontal cylinders. P.G.Morgan

536.5.081

3398. THE HELIUM VAPOR-PRESSURE SCALE OF TEMPERATURES. F.G.Brickwedde.
Phys. Today, Vol. 11, No. 4, 23-5 (April, 1958).

The alternative scales proposed by Clement and by van Dijk and Durieux in 1955 were discussed at a conference at the National Bureau of Standards, Washington, in July 1957. It was agreed that these workers should cooperate in producing a new scale, based on the thermodynamic equation but giving due weight to data obtained with secondary thermometers. This decision was reported at the Low Temperature Conference held at Madison, Wisconsin, in August, 1957. R.G.Chambers

536.512

3399. CALIBRATION OF LIQUID-IN-GLASS THERMOMETERS. J.F.Swindells.
Circ. Nat. Bur. Stand., No. 600, 21 pp. (1959).

Contains information of general interest to both manufacturers and users of liquid-in-glass thermometers. Important elements of thermometer design are discussed, and eligibility requirements for N.B.S. certificates or reports of tests are given. Factors affecting the use of common types of liquid-in-glass thermometer are included, together with tables of tolerances and reasonably attainable accuracies. The calculation of corrections for the temperature of the emergent stem is given in detail for various types of thermometer and conditions of use. The techniques and equipment used in the calibration procedures are given and instructions provided for applicants requiring N.B.S. thermometer calibration services.

536.52

3400. A FULL RADIATION PYROMETER SUITABLE FOR TEMPERATURE MEASUREMENTS IN THE RANGE 0° TO 100°C. M.G.Davies and H.Kronberger.
Atomic Energy Res. Establ. (Harwell), Rep. GP/R2372, 3 pp. (1958).

The instrument has, in vacuo, an accuracy of $\frac{1}{2}$ deg C at 70°C. The action depends on a thermal null method, a differential thermocouple being used as the detector. Readings are therefore independent of the emissivity of the surface.

536.521

3401. PHOTOMETRY OF THE OPTICAL PYROMETER AND ITS USE BELOW 800°C. D.R.Lovejoy.

J. Opt. Soc. Amer., Vol. 49, No. 3, 249-53 (March, 1959).

The standard deviation of temperature measurements due to uncertainty in photometric matching was determined for the disappearing filament optical pyrometer, with and without a red filter, for exit pupils of 0.7 mm and 1.4 mm diameter and for filament apparent angular widths of 10 min and 7 min. It is shown that the results are in quantitative agreement with the direct measurements of contrast limens reported by Blackwell. With a good commercial pyrometer in which the red filter has been removed it is possible to make measurements with a standard deviation for a single pair of observations of 6°C at 600°C.

536.531

3402. A LOW-TEMPERATURE RESISTANCE THERMOMETER USING P-TYPE GALLIUM ARSENIDE. R.F.Broom.

J. sci. Instrum., Vol. 35, No. 12, 467-8 (Dec., 1958).

The construction and calibration of the thermometer are described. The thermometer consisted of a single crystal of copper-doped gallium arsenide with copper-plated contacts. The resistivity of the thermometer material was 2.5×10^5 ohm cm at 4.2°K, and the sensitivity, defined as $TR^{-1}(dR/dT)$, was approximately constant at 2.5 over the range 2 to 25°K. The thermometer was photoconductive and must be screened from light for reliable readings.

S.Weintroub

536.531

3403. EXPERIMENTAL MODELS OF A HIGH TEMPERATURE THERMISTOR. P.T.Oreshkin.

Zh. tekh. Fiz., Vol. 28, No. 7, 1408-12 (1958). In Russian.

The semiconductor resistance thermometers (S.R.T.) consisted of Al_2O_3 elements between SiC electrodes. It was shown that although the conductivity of the measuring elements decreased (sometimes by a factor of 10) during the first 50 hr at 1500°C, due to change of the microstructure, diffusion of SiC in Al_2O_3, and burning off of impurities such as Na, Zn and Pb, the stability of S.R.T. after this preliminary annealing was quite satisfactory. Since no significant change in the calibration curves of two experimental models (whose detailed description is given) was observed after 50 hr continuous use at 1500°C, it is concluded that S.R.T.s of this type are suitable for temperature measurements at 1000-1600°C.

M.H.Sloboda

536.532

3404. TEMPERATURE ERROR ASSOCIATED WITH IMBEDDED THERMOCOUPLES. A.R.Thomas, B.Schurin and J.C.Morris.

Rev. sci. Instrum., Vol. 29, No. 11, 1045-6 (Nov., 1958).

The error in surface temperature of a thin plate in a vacuum as measured by an imbedded thermocouple was investigated experimentally and theoretically. It was found that the error is proportional to the $\frac{5}{2}$ power of the absolute temperature provided the surrounding temperature is much lower than the plate temperature.

536.581.3 : 537.533.7

3405. CRYOSTAT FOR ELECTRON BOMBARDMENT AND ELECTRON DIFFRACTION WORK. E.M.Hörl and L.Marton.

Rev. sci. Instrum., Vol. 29, No. 10, 859-61 (Oct., 1958).

A cryostat is described for the production of free radicals by electron bombardment of condensed gases at liquid helium and liquid hydrogen temperatures. Provisions are made for simultaneous investigations of the bombardment products by electron diffraction and optical spectroscopy.

536.631

3406. THE SPECIFIC HEATS OF IRON AND NICKEL. S.Valentiner.

Optik, Vol. 15, No. 6, 343-57 (June, 1958). In German.

In an attempt to resolve discrepancies among published experimental values, the specific heats of iron and nickel have been calculated from their spontaneous magnetization and atomic vibrations. The results indicate which of the published determinations are to be preferred, and suggest that anomalies in the specific heat–temperature relationship only occur when the specific heats are derived from heat content determinations.

R.F.S.Hearmon

536.631 : 537.312.6

HEAT CAPACITY OF SUPERCONDUCTING ZINC. See Abstr. 2352

THERMODYNAMICS

536.7

3407. THERMODYNAMIC PROPERTIES OF ARGON AT TEMPERATURES BETWEEN 0°C AND −140°C AND AT DENSITIES UP TO 640 AMAGAT (PRESSURES UP TO 1050 atm). A.Michels, J.M.Levelt and G.J.Wolkers.

Physica, Vol. 24, No. 10, 769-94 (Oct., 1958).

From compressibility isotherms of argon published previously, values of energy, entropy, free energy; enthalpy, free enthalpy, internal kinetic energy, specific heats, speed of sound and Joule–Thomson coefficient are calculated. The data are presented at integral values of density and of pressure. The values of the Joule–Thomson coefficient are compared with literature data.

536.7

3408. STATISTICAL THERMODYNAMICS OF MIXTURES. S.G.Brush.

Trans Faraday Soc., Vol. 54, Pt 12, 1781-5 (Dec., 1958).

The general quasi-chemical approximation for the Ising problem is formulated, following the method of Guggenheim. The implicit equation determining the critical solution temperature is given (confirming a result of Barker), and it is shown how the energy and entropy of mixing may be calculated. Two new results are given for the square lattice.

536.7 : 539.18

3409. ISOTOPIC MIXTURES. I.Prigogine and A.Bellemans.

Nuovo Cimento Suppl., Vol. 9, No. 1, 342-4 (1958).

Thermodynamic properties of isotopic mixtures are, to a good approximation, determined by the properties of the components and by some general results of statistical mechanics which may involve specific quantum effects. In this note a brief review of the theory is given and numerical results for the mixtures of the helium and hydrogen isotopes are presented. Agreement with experiment is fair.

R.Eisenschitz

536.71

3410. SOME THERMODYNAMIC PROPERTIES OF FREON-12. D.Pnueli.

Bull. Res. Coun. Israel, Vol. 6C, No. 3, 203-4 (Aug., 1958).

The isothermal and isentropic exponents of the gas are calculated as functions of temperature for constant reduced pressures, P/P_{crit}.

W.Good

536.722

3411. ENTROPY–ENTHALPY DIAGRAM FOR WATER VAPOUR AND LIQUID EXTENDED TO HIGHER TEMPERATURES [600-800°C] AND PRESSURES [300-2000 BARS]. M.Bäckström.

Acta polytech., No. 207 (1956) [Phys. incl. Nucleonics Ser., Vol. 3, No. 8] 23 pp. = K. Tekn. Högsk. Handl., No. 104.

536.722

3412. THE TEMPERATURE DEPENDENCE OF THE ENTHALPY OF FORMATION, FREE ENTHALPY OF FORMATION AND DISSOCIATION CONSTANT OF NITROGEN. J.Himpan.

Z. Naturforsch., Vol. 11a, No. 9, 761-2 (1956). In German.

The most recent measurements for the dissociation energy of nitrogen valid for 0°K are appreciably higher than those hitherto accepted and have necessitated a recalculation of the enthalpy of formation, the free enthalpy of formation, and the dissociation constant of nitrogen. The data are tabulated for the temperature range 298.16-5000°K.

H.H.Hodgson

536.77

3413. THERMODYNAMICS OF THE Au–Pt SYSTEM. R.J.Weiss and K.J.Tauer.

J. Phys. Chem. Solids, Vol. 7, No. 2-3, 249-51 (Nov., 1958).

The electronic, lattice, and mixing free energies are separated for the Au–Pt system, and it is shown that the asymmetric segregation in this system can be ascribed to the filling of the d band at ~ 30 per cent gold. The value of the segregation potential $6R(V_{AA}+V_{BB}-2V_{AB})/k$ is derived as ~ 6090 cal/mole.

ELECTRICITY

ELECTROSTATICS . DIELECTRICS

537.22

3414. CHARGE TRANSFER UPON CONTACT BETWEEN METALS AND INSULATORS. D.O.Van Ostenburg and D.J.Montgomery.
Textile res. J., Vol. 28, No. 1, 22-31 (Jan., 1958).

The equilibrium charge distribution between substances in contact is calculated in the one-dimensional approximation for metal—insulator and insulator—insulator contacts. The direction of charge transfer is such as to equalize the Fermi levels, and the magnitude of charge transferred depends on the positions of the energy bands in the substances in contact. For example, in an insulator it is possible to have a large density (~ 10^{11} esu) within a thin layer (~ 10^{-8} cm) or a small charge density (~ 10^{-1} esu) in a thick layer (~ 10^{-1} cm), to give the same potential shift (~ 1 eV), depending on the relative position of the bands. The energy levels in most insulators of high resistivities are too poorly known to allow strict quantitative comparison with experiment, but the results permit a semiquantitative explanation of some observations on static electrification.

537.221

3415. STATIC ELECTRIFICATION. L.B.Loeb.
Berlin/Göttingen/Heidelberg: Springer-Verlag (1958) xii + 240 pp.

A detailed and often critical account of the phenomena with a comprehensive discussion of recent theoretical interpretations of electrification effects. The following principal subjects are treated in chapters or groups of chapters: electrification by electrolytic processes, contact potential differences, spray electrification, electrification on solid—solid contact and the generation of static charges by processes involving ionization of gases etc. 135 references. J.D.Craggs

537.221 : 531.4

3416. RELATION OF CHARGE TO FRICTIONAL WORK IN THE STATIC ELECTRIFICATION OF FILAMENTS.
J.B.Levy, J.H.Wakelin, W.J.Kauzmann and J.H.Dillon.
Textile res. J., Vol. 28, No. 11, 897-911 (Nov., 1958).

A study of the generation of electrical charge on fibrous materials was carried out using the apparatus of Hersh and Montgomery, in which a fibre is held fixed in an insulated lower yoke while a second fibre in a grounded upper yoke is rubbed across it under controlled ambient and mechanical conditions. The original apparatus was modified to permit measurement of the frictional work of rubbing as well as the charge. Precautions were taken to discharge both fibres with a radioactive source after each measurement. It was found that, at any one velocity, several thousand rubs were required before steady values of charge transferred and frictional work of rubbing were obtained. It was also found that the velocity of rubbing affected strongly both the charge transferred and the frictional work of rubbing, the former being found to decrease and the latter to increase with increasing velocity This has been explained in terms of local heating, plastic junctions, and material transfer which occur during rubbing. An empirical relationship relating the velocity of rub, the frictional work of rubbing, and the charge transferred was found to hold in the great majority of the cases examined. From the experimental data obtained it was possible to calculate the mechanical energy expended in any one rub and to estimate the resulting electrical energy. Thus for any pair of fibres under a given set of conditions it was possible to calculate the efficiency of the process of converting mechanical energy to triboelectrical energy. At 30° C and 33% R.H. measured efficiencies were very low (0.00-0.42%); at a very low humidity, efficiencies as high as 2.0% were found. The presence of a lubricant on the fibre surfaces during rubbing was found in most cases to cause a decrease in both the charge and frictional work of rubbing.

537.226.08

3417. THE "FORCE" METHOD OF DETERMINING THE STATIC DIELECTRIC CONSTANT OF CONDUCTING LIQUIDS WITH PARTICULAR REFERENCE TO SULPHURIC; NITRIC AND CHLOROSULPHONIC ACIDS. R.J.Gillespie and R.F.M.White.
Trans Faraday Soc., Vol. 54, Pt 12, 1846-54 (Dec., 1958).

Techniques have been developed to enable the Fürth "force" method to be applied to the problem of determining the dielectric constants of conducting and viscous liquids. Values of the dielectric constants of sulphuric, nitric and chlorosulphonic acids have been obtained.

537.226.1 : 621.319.45 : 621.315.61

3418. IMPEDANCE OF DIELECTRIC LAYERS.
P.Winkel and D.G. de Groot.
Philips Res. Rep., Vol. 13, No. 5, 489-98 (Oct., 1958).

It is shown that, according to a theory on amorphous dielectrics given earlier by Gevers and Du Pré, a correlation must exist between the real and imaginary component of the impedances of a dielectric layer. This correlation has in fact been observed with dielectric layers formed by the anodic oxidation of Al and Ta, which are known to be amorphous. New data on these layers are presented. They reveal no indication that these layers have any strongly asymmetric structure, as has been suggested in literature in connection with experiments on niobium oxide. The experimental results with aluminium-oxide layers, containing some boehmite, can only be explained by the present theory.

537.226.1 : 539.2

3419. THEORY OF THE CONTRIBUTION OF EXCITONS TO THE COMPLEX DIELECTRIC CONSTANT OF CRYSTALS. J.J.Hopfield.
Phys. Rev., Vol. 112, No. 5, 1555-67 (Dec. 1, 1958).

It is shown that the ordinary semiclassical theory of the absorption of light by exciton states is not completely satisfactory (in contrast to the case of absorption due to interband transitions). A more complete theory is developed. It is shown that excitons are approximate bosons, and, in interaction with the electromagnetic field, the exciton field plays the role of the classical polarization field. The eigenstates of the system of crystal and radiation field are mixtures of photons and excitons. The ordinary one-quantum optical lifetime of an excitation is infinite. Absorption occurs only when "three-body" processes are introduced. The theory includes "local field" effects, leading to the Lorentz local field correction when it is applicable. A Smakula equation for the oscillator strength in terms of the integrated absorption constant is derived.

537.226.1

3420. POLARIZABILITY OF A DILUTE SOLID SOLUTION OF DIPOLAR MOLECULES AT LOW TEMPERATURE. J.A.Sussmann.
Rep. Brit. Elect. Res. Assoc., Rep. L/T347, 7 pp. (1956).

The polarizability of a dipolar gas is known to be proportional to 1/T down to temperatures where kT is comparable to the energy difference between the ground state and first excited state (T of the order of 100°K). It is shown that, in a dilute solid solution of dipolar molecules, the deviation from 1/T proportionality will start at much lower temperatures (of the order of 10^{-6} °K).

537.226.1 : 532.7

DIELECTRIC SATURATION AND INTERMOLECULAR FORCES IN LIQUIDS. See Abstr. 3202

537.226.2

3421. ANISOTROPY OF THE DIELECTRIC PROPERTIES OF ORIENTED BARIUM FERRITE. J.Rupprecht and C.Heck.
Naturwissenschaften, Vol. 45, No. 21, 511 (1958). In German.

Measurements of permittivity and dielectric loss were made over the frequency range 60 kc/s to 30 Mc/s. In this range the permittivity dropped from about 10^4 to values around 10^2. Throughout the range, pronounced anisotropy was observed, the permittivity in the direction of easy magnetization being about one half as great as in the perpendicular direction. The dispersion theory of Koops is mentioned, but detailed explanation is reserved for a full paper.
K.W.Plessner

537.226.2

3422. DIELECTRIC EFFECTS OF FLAWS IN HYDROGEN BONDING. V.Daniel.
Trans Faraday Soc., Vol. 54, Pt 12, 1834-45 (Dec., 1958).

A wide range of long-chain secondary alcohols have anomalously high permittivities when solidified in certain ways. It is shown that this effect is due to structural flaws, in that the chains of hydrogen bonds formed by the hydroxyl groups are polarizable only in conjunction with flaws. The evidence suggests that the flaws in question may be intersections of two or more chains of hydrogen bonds. The details of the way in which the intersections cause polarizability are not yet fully understood.

537.226.2

3423. IONIZATION PROCESSES IN PORES OF CERAMIC DIELECTRICS. I.E.Balȳgin and P.S.Mikhaĭlov.
Zh. tekh. Fiz., Vol. 28, No. 8, 1684-91 (1958). In Russian.

Using a Schering bridge and also an electronic detector for observing discharges, electrical characteristics were studied of specially prepared high-porosity ceramics. Under a.c. conditions ionization takes place in the pores at a stress which is lower the greater the size of the pores. The ionization gives rise to evolution of heat. Under d.c. stresses, ionization in gas pores is observed when the conductivity of walls of the pores is abnormally high.

Z.Krasucki

537.226.2 : 539.19

DIELECTRIC CONSTANT AND MOLECULAR RELAXATION OF ORGANIC LIQUIDS. See Abstr. 2889

537.226.2 : 621.319.4 : 621.315.612.8

3424. THE ELECTRICAL PROPERTIES OF TUNGSTEN TRIOXIDE. J.Hirsch.

Rep. Brit. Elect. Res. Assoc., Rep. L/T351, 10 pp. (1956).

Continuation of Abstr. 3396B (1958); Rep. Brit. Elect. Res. Assoc., Rep. L/T326, 33 pp. (1955). Describes the preparation and the electrical properties of WO$_3$ in ceramic form, using denser specimens than were achieved in the earlier work. It is concluded that there is no electrical evidence of a ferroelectric state in WO$_3$, between −180° and +100°C. The permittivity at −180°C lies between 25 and 30. The true value at room temperature, after correction for the effects of interfacial polarization, is probably not much higher. The material is much too conductive to be of practical interest as a dielectric. The conductivity is decreased by some additives, but not sufficiently to render the material useful. A thermal hysteresis in permittivity and conductance was observed, but no electrical hysteresis could be detected. Some errors in the previous report are corrected.

537.226.2

3425. AMMONIUM HYDROGEN SULFATE: A NEW FERROELECTRIC WITH LOW COERCIVE FIELD.

R.Pepinsky, K.Vedam, S.Hoshino and Y.Okaya.

Phys. Rev., Vol. 111, No. 6, 1508-10 (Sept. 15, 1958).

$(NH_4)HSO_4$ is ferroelectric in the temperature range between −3°C and −119°C. The symmetry of the room-temperature phase is $P2_1/c$; the ferroelectric phase is also monoclinic, with space group Pc; and the lowest phase, which is piezoelectric, has triclinic symmetry P1. All three phases are pseudo-orthorhombic. The coercive field is very low: about 150 V/cm at −13°C. The spontaneous polarization P_S is about 0.4 $\mu C/cm^2$ at that temperature, and rises to a maximum of about 0.8 $\mu C/cm^2$ just above −119°C. P_S falls to zero abruptly at the lower transition point. The higher transition is of second order, and the lower of first order.

537.226.2

3426. ULTRASONIC MEASUREMENT OF POLARIZATION SWITCHING PROCESSES IN BARIUM-TITANATE SINGLE CRYSTAL.

K.Husimi and K.Kataoka.

J. appl. Phys., Vol. 29, No. 8, 1247-51 (Aug., 1958).

A previously non-destructive piezoelectric method for studying the state of polarization of ferroelectric crystals is applied to study polarization switching in barium titanate single crystals. Three polarization processes are proposed. The first and second processes were designated nucleation and growth by Merz. The third process cannot be measured by conventional pulse methods, and has a very slow polarizing velocity. This indicates the existence of layers which lie between the surface layer and inner layer. Switching time results are considered in the light of the above experiments.

537.226.2

3427. POLARIZATION CHANGES DURING THE PROCESS OF AGEING IN FERROELECTRICS OF THE BaTiO$_3$-TYPE.

Z.Pająk and J.Stankowski.

Proc. Phys. Soc., Vol. 72, Pt 6, 1144-6 (Dec., 1958).

The gradual closing up of the P—E hysteresis loop of BaTiO$_3$ ceramic on ageing is described, and a qualitative explanation is given in terms of stress relaxation within grains. The authors' earlier observation of a shift in Curie point due to ageing is now interpreted as part of the ageing—rejuvenation cycle.

K.W.Plessner

537.226.3

3428. DEBYE LOSSES DUE TO ELECTRONS TRAPPED AT VACANCIES. J.A.Sussmann.

Rep. Brit. Elect. Res. Assoc., Rep. L/T348, 7 pp. (1956).

Vacancies in some crystals trap electrons. The conditions under which such trapped electrons give rise to Debye type of electric loss are discussed. It is shown that such behaviour can be expected when the vacancy has either three or four equal, equidstant, nearest neighbours, provided the wave function of an extra electron has p symmetry near each of the neighbouring atoms. Some possible applications are discussed.

537.226.3 : 535.37

PHOSPHORESCENCE AND PHOTODIPOLAR EFFECT. See Abstr. 3324.

537.228.1

3429. THEORY OF THE PIEZOELECTRIC EFFECT IN THE ZINCBLENDE STRUCTURE. J.L.Birman.

Phys. Rev., Vol. 111, No. 6, 1510-14 (Sept. 15, 1958).

A theory of the piezoelectric effect in the zincblende structure is developed on the basis of two assumptions: (1) that the Born theory of a homogeneous lattice deformation is applicable, and (2) that each chemical bond is characterized by a vector bond dipole moment. The theory leads to an equation relating the macroscopic piezoelectric constant to the static and dynamic effective charges (properties of the bond moment), and a lattice parameter γ_{14} which relates the internal strain (basis deformation) to the external strain. An X-ray method for measuring γ_{14} is discussed; it utilizes the failure of Friedel's rule in the anomalous dispersion region. An order-of-magnitude check of the theory is made on ZnS. Some remarks are made about the piezoelectric effect in wurtzite based on the same model.

537.228.3

3430. THE ELECTRICAL DOUBLE (LIGHT) REFRACTION OF POLYSTYROL SOLUTIONS.

V.A.Marinin, L.V.Polyakova and Z.S.Korol'kova.

Vestnik Leningrad. Univ., (1958), No. 16, Ser. Fiz. Khim, No. 3, 73-7. In Russian.

Measurements were made on seven polystyrol fractions in CCl$_4$ solution with molecular weights ranging from 4.0×10^3 up to 5.0×10^6. It is found that the Kerr effect constant does not depend upon molecular weight, in fact it is +ve and of magnitude near to that of styrol.

C.R.S.Manders

537.29 : 536.22

INFLUENCE OF ELECTRIC FIELDS ON THE HEAT TRANSFER IN LIQUIDS. See Abstr. 3378

ELECTRIC CONDUCTION

SEMICONDUCTORS

537.311 : 539.2

QUENCHED IMPERFECTIONS AND THE ELECTRICAL RESISTIVITY OF ALUMINIUM AT LOW TEMPERATURES. See Abstr. 2916

537.311.3

3431. THE MEAN LIFETIME OF PHOTOELECTRONS IN AgCl.

P.Süptitz.

Naturwissenschaften, Vol. 44, No. 24, 629-30 (1957). In German.

A very brief note referring to difficulties encountered in repeating earlier measurements of Haynes and Shockley. See Abstr. 3633 (1949).

J.D.Craggs

537.311.31 : 537.312.62

3432. THE ELECTRICAL RESISTIVITY AND SUPERCONDUCTIVITY OF SOME URANIUM ALLOYS AND COMPOUNDS.

B.S.Chandrasekhar and J.K.Hulm.

J. Phys. Chem. Solids, Vol. 7, No. 2-3, 259-67 (Nov., 1958).

The electrical resistivity and superconductivity of a series of α (orthorhombic) and quenched γ (body-centred cubic) binary alloys of uranium with niobium and molybdenum were investigated at temperatures down to 1°K. Anomalous resistivity behaviour occurs in both types of structure. The γ-alloys are particularly unusual in possessing a negative temperature coefficient from room temperature down to the superconducting transition point. Both systems exhibit superconducting transitions, the γ-alloys in the vicinity of 2°K and the α-alloys closer to 1°K. Some success was achieved in a qualitative interpretation of the resistive and superconductive properties of the alloys in terms of a hypothetical band structure of uranium. Ten intermetallic compounds of uranium were also tested for superconductivity down to about 1°K. Four new superconductors were discovered: UCo (1.70°K), U$_6$Mn (2.32°K), U$_6$Fe (3.86°K) and U$_6$Co (2.29°K). The last three compounds are isomorphous and include the first superconducting compounds of manganese and iron.

537.311.31 : 538.632 : 539.2

3433. CRYSTAL ANISOTROPY AND MAGNETOSTRICTION FROM THE HALL EFFECT IN FERROMAGNETIC MATERIALS.

W.Jellinghaus and M.P.de Andrés.
Naturwissenschaften, Vol. 45, No. 21, 508 (1958). In German.

Reports measurements of the Hall effect in strips cut from oriented 3.3% silicon iron in directions corresponding to the [100], [110] and [111] crystal directions. The effect of tension on the Hall effect in four different ferromagnetic materials was also measured. A.E.De Barr

537.311.31 : 538.63

3434. HALL EFFECT, MAGNETORESISTANCE, AND SIZE EFFECTS IN COPPER. T.G.Berlincourt.

Phys. Rev., Vol. 112, No. 2, 381-7 (Oct. 15, 1958).

Measurements of the Hall coefficient of several annealed polycrystalline Cu strips of resistivity ratio $\rho(273^\circ K)/\rho(4.2^\circ K) \sim 450$ and thicknesses ranging from 0.05 to 1.6 mm have revealed the existence of a marked size effect at low temperatures. The effect is orders of magnitude greater than that to be expected on the basis of free-electron theory. It is suggested that earlier low-temperature data on the Hall effect of thin high-purity samples are subject to uncertainties arising from such effects. Size effects were also evident in the transverse magnetoresistance. At high fields, a tendency toward saturation in the transverse magnetoresistance was observed for thick samples. The temperature dependence of the Hall coefficient has also been studied.

537.311.31

3435. RESISTANCE VARIATION OF THIN METALLIC FILMS BY GAS ADSORPTION. (EXPERIMENTS ON SELF-SUPPORTED COPPER FILMS). S.Tunakan.

Rev. Fac. Sci. Univ. Istanbul C, Vol. 21, No. 4, 277-87 (Oct., 1956). In German.

For previous work see Abstr. 4320 (1957). The effect of adsorption of O_2, H_2 or He on the electrical resistance at 0°C of specimens, 255 mμ thick and with a freely supported region 12 × 1 mm, which had previously been heated to red heat and maintained in vacuo for considerable time, was investigated. Introduction of O_2 and H_2 causes the resistance to increase suddenly and then to rise slowly with time, the relative change being about twice as great for O_2 as for H_2. No effect was observed for He. S.Weintroub

537.311.31

3436. RESISTANCE VARIATION OF THIN METALLIC FILMS BY GAS ADSORPTION. (EXPERIMENTS ON SELF-SUPPORTED GOLD FILMS). S.Tunakan.

Rev. Fac. Sci. Univ. Istanbul C, Vol. 21, No. 4, 288-94 (Oct., 1956). In German.

See preceding abstract. Similar experiments to those made on copper and silver were performed on gold specimens, 182 mμ thick. No measurable resistance change was observed in He at 10^{-1} mm Hg pressure. The effect of introduction of O_2 and H_2 was similar to that for the other films, but the initial rise in O_2 was negligibly small. S.Weintroub

537.311.32 : 536.212

3437. ELECTRICAL AND THERMAL RESISTIVITY OF THE TRANSITION ELEMENTS AT LOW TEMPERATURES.

G.K.White and S.B.Woods.
Phil. Trans. A, Vol. 251, No. 995, 273-302 (1959).

The results of measurements on 20 transition elements are reported giving values for the thermal resistivity W from 2° to about 140°K and for electrical resistivity ρ from 2° to 300°K. Values of the "ideal" resistivities W_i and ρ_i (due to scattering of the electrons by thermal vibrations) are deduced from these and tabulated for various temperatures. Comparisons are made with values for Cu, Ag, Au and Na and with the predictions of the "standard" theory, i.e. solutions of the transport equation developed by Bloch, Grüneisen, Wilson, etc. Excepting Mn, ρ_i follows a Bloch–Grüneisen function tolerably down to $\theta_D/5$, although slight anomalies are shown by V, Cr, Fe, Co and Ni; at low temperatures behaviour is varied but below 10°K in Mn, Fe, Co, Ni, Pd, Pt and perhaps in W and Nb, ρ_i appears to vary nearly as T^2. The parameter $\rho_i M\theta_D^2\Omega^{1/3}$ (at 273°K) has rather similar values for different members of each group, e.g. for Ti, Zr and Hf of group IVA. The ideal thermal resistivity W_i can generally be approximated by the relation,

$$W_i/W_\infty = 2(T/\theta)^2 J_3(\theta/T),$$

although for many elements, W_i falls more rapidly than T^2 below $\theta/10$. Measurements on the relatively poor conductors, e.g. Ti, Zr and Hf, suggest the presence of an appreciable lattice conductivity, which affects the confidence with which values can be deduced for W_i in these elements.

537.311.32 : 536.413.2

3438. RESISTIVITY AND DILATATION OF ALCOMAX III.

M.McCaig and A.G.Clegg.
Rep. Brit. Elect. Res. Assoc., Rep. N/T76, 2 pp. (1957).

537.311.32

3439. ON THE ELECTRIC RESISTANCE OF VERY THIN ALUMINIUM LAYERS. S.Tunakan.

Rev. Fac. Sci. Univ. Istanbul C, Vol. 22, No. 2, 139-59 (April, 1957). In German.

Films of 3-10 mμ were vacuum-deposited on glass and the resistance measured as a function of temperature and also of the effect of atmospheres of hydrogen and oxygen. Large increases in resistance were found for an oxygen atmosphere but little change for hydrogen atmosphere. J.M.Hough

537.311.33

3440. ON A SIMPLE MODEL FOR IMPURITY BAND CONDUCTION. K.Helmers.

Philips Res. Rep., Vol. 14, No. 1, 1-10 (Feb., 1959).

The influence of the randomness in impurity centre positions on impurity band conduction can be studied using a crude model (stochastic resistance network). Further simplification of the model leads to the stochastic resistance chain, the statistical theory of which is developed. Here, typical one-dimensional effects appear at small impurity centre concentrations.

537.311.33

3441. CONDUCTIVITY OF NONPOLAR CRYSTALS IN STRONG ELECTRIC FIELD. II. J.Yamashita.

Phys. Rev., Vol. 111, No. 6, 1529-32 (Sept. 15, 1958).

For Pt I, see Abstr. 3722 (1955). The distribution function of the "hot electron" is investigated in germanium for the case of a small applied electric field, where both acoustical- and optical-mode scattering exists. The electron energy loss due to the interaction with the optical mode is found to be quite large and it eliminates large parts of the quantitative discrepancy between the previous theory and experiment.

537.311.33

3442. THE THEORY OF THE HALL EFFECT IN POLAR SEMICONDUCTORS. T.Okada.

Mem. Fac. Sci. Kyusyu Univ. B, Vol. 2, No. 2, 1-12 (Nov., 1956).

The electronic theory of the Hall effect in polar semiconductors was studied; it is assumed that the conduction electron is free, and the electron-lattice interaction is the same as that of Fröhlich-Mott. The time rate of change of the distribution function for the conduction electron is calculated by the method of Howarth-Sondheimer; and the transport equation including the magnetic field is solved by means of the Kohler's variation principle. The effective relaxation time for the conduction (τ_c) and that for the Hall effect (τ_h) and that for the magneto-resistance effect (τ_m) can be defined, and the numerical computation shows that τ_c, τ_h and τ_m have practically the same order of magnitude and the nearly same dependency on temperature as the classical phenomenological theory.

537.311.33 : 621.382

3443. THE HALL-GENERATOR WITH FEEDBACK. H.Weiss.

Z. Naturforsch., Vol. 11a, No. 9, 684-8 (1956). In German.

The very high electron mobility u found in the semiconductors InSb and InAs has made it possible to use the Hall-potential regeneratively. For InAs at room temp. $u \cong 23 \times 10^3$ cm^2/V sec, and in a field of 10^4 Oe an efficiency (i.e. ratio of power delivered by Hall probes to power consumed by controlling current in Hall generator) of 8% can be obtained, with a practical Hall power output of 200 mW. The time constant increases with increasing coupling and becomes infinite for the case of self excitation. For still stronger coupling it falls again (with sign reversal). F.Ansbacher

537.311.33

3444. ON THE THEORY OF SEMICONDUCTOR ENERGY CONVERTORS. B.Ya.Yurkov.

Zh. tekh. Fiz., Vol. 28, No. 7, 1365-70 (1958). In Russian.

Based on the theory of the energy losses by high energy electrons due to Spencer (see Abstr. 7117/1955), a theory of semiconductor devices converting the energy of monoenergetic electrons into electrical energy is formulated. A general expression for the short-circuit current is derived which can be also used for practical calculations. M.H.Sloboda

537.311.33

3445. THE INFLUENCE OF ORBITAL QUANTIZATION IN A MAGNETIC FIELD ON THE FERMI LEVEL IN SEMICONDUCTORS. I.

J.Appel.

Z. Naturforsch., Vol. 11a, No. 9, 689-93 (1956). In German.

The influence of orbital quantization on the Fermi-level is investigated for impurity semiconductors, with and without the effect of the splitting of energy levels of donors and acceptors being considered. For a simple excess semiconductor with discrete donor levels, whose parameters correspond to pure n-type Ge for example, the Fermi level and the concentration n of electrons in the L-band are calculated as functions of the magnetic field H and temperature T. For weak H and low T, n is given explicitly in terms of H. For defect semiconductors these results lead, in the case of p-type InSb (effect electron mass $m^* = \frac{1}{6}$ in.) with term splitting of acceptor levels according to a Lande factor $g = 1$, to a positive magnetoresistive effect at 4°K. F.Ansbacher

537.311.33 : 539.2

ON THE EFFECTIVE MASS OF ELECTRONS IN CRYSTALS.

See Abstr. 2905

537.311.33

3446. PHASE SHIFT METHOD OF CARRIER LIFETIME MEASUREMENTS IN SEMICONDUCTORS.

E.Harnik, A.Many and N.B.Grover.

Rev. sci. Instrum., Vol. 29, No. 10, 889-91 (Oct., 1958).

A direct reading instrument for lifetime measurements in semiconductors is described. It is based on the phase shift that exists between a sinusoidal modulation of carrier injection and the corresponding modulation of specimen conductance. Carrier injection is effected optically, a Kerr cell being used to modulate the intensity of the injecting light. The phase shift is determined by means of a compensating RC circuit which allows a direct reading of lifetime. The actual measurement is reduced to the setting of a variable resistor in such a way that an ellipse observed on the screen of a CRO degenerates into a straight line. The performance of the instrument is discussed for the case of a thin, rectangular filament illuminated on one of its large faces either homogeneously or in a narrow band.

537.311.33

3447. A NOTE ON SURFACE RECOMBINATION VELOCITY AND PHOTOCONDUCTIVE DECAYS. A.C.Sim.

J. Electronics and Control, Vol. 5, No. 3, 251-5 (Sept., 1958).

A mathematical discussion of the magnitude of the correction factor λ in the expression $1/\tau_0 = 1/\tau + \lambda/\tau$, where τ_0 is the effective lifetime and τ is the true bulk lifetime of a sample of semiconductor material. The following approximations to λ are derived for the ranges of validity stated: (1) S/W, all t and $WS < 2$; (2) S/W, $t < W^2/5$ and $t < 1/5S^2$; (3) $5/2W^2$, $t > W^2/10$ and $WS > 10$; (4) $(5/2W^2)\{WS/(1+WS)\}^2$, $t > W^2$, $t > W^2/8$ and $WS > 4$; and (5) $2/W(\pi t)^{1/2}$, $t < W^2/5$ and $t < 5/S^2$; where $2W$ is the thickness of the sheet-like sample, in units of the diffusion length L; S is the surface recombination velocity, in units of the diffusion velocity L/τ; and t is the time in units of τ. The slight changes required for a cylindrical sample are also given. F.F.Roberts

537.311.33

3448. THE KINETICS OF SOME ELECTRONIC PROCESSES IN SEMICONDUCTORS.

V.E.Lashkarev, É.I.Rashba, V.A.Romanov and Z.A.Demidenko.

Zh. tekh. Fiz., Vol. 28, No. 9, 1853-70 (1958). In Russian.

A theoretical treatment is given for the kinetics of rise and decay of the photomagnetic effect, the photoconductive effect (with and without magnetic field), and the bulk photovoltaic effect due to inhomogeneities in the specimen. The determination of the parameters of surface and bulk recombination by the simultaneous study of several of these effects is discussed; trapping may be easily detected by measurements on the photoconductive and voltaic effects. The general formulae obtained are applied to several particular cases. Experiments are described in which Ge specimens with various surface treatments were subjected to intermittent illumination through a Kerr cell; the frequency dependences of the phases and amplitudes of the photoconductive and voltaic effects were measured and compared with the theory. K.F.Hulme

537.311.33 : 538.63

3449. THE ELLIPSOID MODEL OF THE GALVANOMAGNETIC EFFECTS IN SEMICONDUCTORS. T.Okada.

Mem. Fac. Sci. Kyusyu Univ. B, Vol. 1, No. 5, 168-81 (Sept., 1955).

Formal tensor analysis is given assuming the existence of multiple bands of the ellipsoid type, and appropriate collision-time, neglecting intervalley scattering, and assuming a weak magnetic field. C.A.Hogarth

537.311.33 : 538.6

3450. ADIABATIC GALVANO- AND THERMO-MAGNETIC PHENOMENA IN SEMICONDUCTORS. I. IMPURITY SEMICONDUCTORS. I.M.Tsidil'kovskiĭ.

Zh. tekh. Fiz., Vol. 28, No. 7, 1371-81 (1958). In Russian.

A mathematical analysis of these effects in isotropic semiconductors for the case of strong magnetic fields. It is shown that in strong magnetic fields all transverse effects are inversely proportional to the effective magnetic field uH/c. In the region of intermediate fields the relationship between any transverse effect and uH/c is characterized by a maximum, the only exception being the Hall effect which is proportional to uH/c in both weak and strong magnetic fields. The longitudinal effects, which in weak fields are proportional to $(uH/c)^2$, do not depend on uH/c in strong fields. In the case of those effects that can be measured both isothermally and adiabatically (except the transverse Nernst–Ettinghausen effect and electron thermal conductivity) the isothermal and adiabatic coefficients are equal in strong magnetic fields. M.H.Sloboda

537.311.33 : 537.323

3451. THERMOELECTRIC POWER OF NON-POLAR SEMICONDUCTORS. J.Appel.

Z. Naturforsch., Vol. 12a, No. 5, 410-24 (May, 1957). In German.

The Boltzmann equations for the distribution functions (including their deviations from thermal equilibrium values) of electron and lattice waves are solved self-consistently for non-degenerate isotropic semiconductors. The following collision processes are considered: for electrons elastic interaction with longitudinal acoustic lattice waves and ionized impurity atoms; and for the longitudinal thermal lattice waves mutual interaction and interaction with electrons and crystal boundaries. Statistical mechanical methods applied to the symmetrical electron-lattice interaction ensures that Onsager's relations are satisfied. The results show that the thermoelectric power Q, in the limiting case when Q can be split into electronic and lattice part, is in quantitative agreement with Herring's theory (see Abstr. 971/1955, 7047/1957). In general, Q cannot thus be split up. Q depends on the purely electric parameters (apparent mass of carriers, their concentration, or their Fermi level), on the properties of the ideal lattice (mean free path of those lattice waves with small propagation vectors which scatter electrons predominantly, velocity of sound) and on the electron-phonon and electron-impurity interactions. One of the results for the thermal current density at low temperatures is a reduction of the lattice conduction depending approximately linearly on the carrier electron concentration. This effect becomes noticeable (> 1%) only for $n > 10^{15}$ cm^{-3} at liquid H temperatures. F.Ansbacher

537.311.33 : 538.66

3452. THEORY OF THE THERMOMAGNETIC EFFECTS OF NON-POLAR ISOTROPIC SEMICONDUCTORS. J.Appel.

Z. Naturforsch., Vol. 13a, No. 5, 386-402 (May, 1958). In German.

The author's previous theory (see preceding abstract), for the simultaneous derivation of the distribution functions of electrons and phonons (acoustic), from the two coupled Boltzmann equations, is extended to include the effect of an applied magnetic field. Besides the mutual scattering of electrons and phonons by one another, the scattering of the former by impurities and the latter by grain boundaries and other phonons is considered. The following isothermal and adiabatic effects are calculated as functions of the magnetic field strength and temperature: the variation of thermoelectric power and thermal conductivity with transverse magnetic field and the Ettinghausen–Nernst effect. Explicit results are given for weak and strong fields while computed results, at intermediate fields, for various values of the scattering parameters, are presented in the form of graphs. The field dependent thermoelectric power of p-type germanium, measured at 80°K, is in good agreement with the calculated result. R.Stratton

537.311.33 : 535.56

3453. ON THE FARADAY EFFECT IN SEMICONDUCTORS.

H.Kimmel.

Z. Naturforsch., Vol. 12a, No. 12, 1016 (1957). In German.

Measured values of Verdet's constant (angular rotation of plane of polarization per unit length and magnetic field strength) are reported for Si, GaP, GaAs and InP in their respective transparent regions. R.Stratton

537.311.33

3454. GLASS-LIKE SEMICONDUCTORS. IV. THE LAWS OF GLASS FORMATION. N.A.Goryunova and B.T.Kolomiets.

Zh. tekh. Fiz., Vol. 28, No. 9, 1922-32 (1958). In Russian.

For Pt III see Abstr. 2238 (1957). The reasons for the formation

of glasses in the complex semiconducting compounds previously described by the authors (Acad. Sciences U.S.S.R. M. p. 38 (1956); Abstr. 2236/1957) are discussed in terms of the chemical bondings. One conclusion is that covalent bonding in solid and melt is essential for glass formation, but tetrahedral covalent bonding in the melt hinders it.
K.F.Hulme

537.311.33 : 539.234

3455. EVAPORATED LAYERS OF SEMICONDUCTING III-V COMPOUNDS. K.G.Günther.
Naturwissenschaften, Vol. 45, No. 17, 415-16 (1958). In German.

Experiments on the improved crystal growth of InAs and InSb layers as the deposition temperature is raised are described. For InSb the Hall electron mobility increases markedly as the thickness of the layer increases and the crystallinity improves.
C.A.Hogarth

537.311.33

3456. OPTICAL AND ELECTRICAL PROPERTIES OF SEMICONDUCTING $A^{I}B^{V}$ COMPOUNDS. H.G.Clerc and G.Wallis.
Z. Naturforsch., Vol. 11a, No. 12, 1040-1 (1956). In German.

The forbidden energy gap of Cs_3Sb (1.6 eV) is greater than that of Cs_3Bi (< 0.55 eV) in line with the similarly observed decrease of the energy gaps of $A^{II}B^{IV}$, $A^{II}B^{VI}$ and $A^{III}B^{V}$ compounds with increasing atomic weight of B.
R.Stratton

537.311.33

3457. CONSTITUTION OF THE $AgSbSe_2$–$AgSbTe_2$–$AgBiSe_2$–$AgBiTe_2$ SYSTEM. J.H.Wernick, S.Geller and K.E.Benson.
J. Phys. Chem. Solids, Vol. 7, No. 2-3, 240-8 (Nov., 1958).

The six pseudo-binary phase diagrams in the semiconducting system $AgSbSe_2$– $AgSbTe_2$–$AgBiSe_2$–$AgBiTe_2$ have been determined. Complete series of solid solutions with the cubic structure exist in this pseudo-quaternary system. The locus of temperatures and compositions for the order–disorder transition has been determined. Lattice constants as a function of composition for the cubic phase and thermoelectric power data for some of the solid solutions are presented.

537.311.33

3458. SEMICONDUCTING COMPOUNDS WITH THE GENERAL FORMULA ABX_2. V.P.Zhuze, V.N.Sergeeva and E.L.Shtrum.
Zh. tekh. Fiz., Vol. 28, No. 10, 2093-108 (1958). In Russian.

A survey of some 25 compounds in two groups: (1) chalcopyrite and related structures for which A is Cu or Ag, B is Al, Ga, In, Tl or Fe, X is S, Se, Te (see also Abstr. 9180/1957); (2) derived NaCl and other structures for which A is Cu or Ag, B is Sb or Bi, X is Se or Te (see also Abstr. 5880/1958). Data are given for most of these compounds, on electrical and other physical properties (e.g. melting point, electrical conductivity). Chemical bonding is discussed for the first group. It is also noted that X-ray powder diagrams for $CuBiTe_2$, $AgBiTe_2$ and $CuSbTe_2$ appear similar in type to those for Bi_2Te_3 (see preceding abstract).
C.H.L.Goodman

537.311.33 : 537.312.5

3459. THE ELECTRICAL CONDUCTIVITY AND PHOTOCONDUCTIVITY OF FILMS OF THE ALUMINIUM–ANTIMONY SYSTEM PREPARED BY VEKSHINSKIĬ'S METHOD.
M.V.Kot and G.P.Sorokin.
Zh. tekh. Fiz., Vol. 28, No. 8, 1657-61 (1958). In Russian.

Films, 0.1 to 1 μ thick, of compositions ranging along their lengths from Al to Sb through intermediate compositions were obtained by the simultaneous evaporation in vacuo of Al and Sb from separate sources on to a glass substrate. For substrate temperatures 20°-230°C the electrical conductivities and photosensitivities measured at various places along the films peaked at the composition AlSb. But for substrate temperatures 230°-300°C maxima also appeared at the composition Al_9Sb; these maxima were greatly diminished after 200 hr at 20°C. It is suggested that there is a semiconducting compound Al_9Sb unstable below 230°C. Measurements on the spectral distribution of its photosensitivity showed a peak at 0.8 μ (suggesting a forbidden gap of 1.6 eV). Plans for further work on Al_9Sb include electron diffraction study.
K.F.Hulme

537.311.33 : 538.632 : 621.315.59

3460. THE ELECTRICAL CONDUCTIVITY AND HALL COEFFICIENT OF BISMUTH TELLURIDE. B.Yates.
J. Electronics and Control, Vol. 6, No. 1, 26-38 (Jan., 1959).

Describes the variation of the electrical conductivity and Hall coefficient of a number of specimens of Bi_2Te_3 over a wide range of doping concentration. A detailed examination of these quantities, over the temperature range 1.3 to 660°K, has revealed the existence of trends which vary systematically with the degree of doping, although anomalies exist within this scheme. It is shown that an impurity band mechanism may operate in n-type Bi_2Te_3.

537.311.33 : 539.2

3461. CHEMICAL BONDING IN BISMUTH TELLURIDE.
J.R.Drabble and C.H.L.Goodman.
J. Phys. Chem. Solids, Vol. 5, No. 1-2, 142-4 (1958).

A model for the chemical bonding in bismuth telluride is proposed which appears to dispose of some of the difficulties involved in earlier models. The new model is used to explain some of the properties of bismuth telluride and of its alloys with bismuth selenide.

537.311.33 : 539.2

3462. THERMOELECTRIC PROPERTIES AND BOND CHARACTER OF THE SYSTEM $Bi_2Te_3 + Sb_2Te_3$.
S.V.Aĭrapetyants and B.A.Efimova.
Zh. tekh. Fiz., Vol. 28, No. 8, 1768-74 (1958). In Russian.

It is suggested that three types of bond exist in the five-layered Te_{II}-Bi-Te_{I}-Bi-Te_{II} structure of Bi_2Te_3(and its solid solutions with Sb_2Te_3): Te_{II}-Bi – covalent, Te_{I}-Bi – ionic, Te_{II}-Te_{II} – residual. (See also Abstr. 9179/1957 and preceding abstract). Data are given on the variation of thermoelectric power, Hall mobility, and effective mass with Sb_2Te_3 content for hot-pressed specimens. N-type specimens could be obtained with up to 50% Sb_2Te_3. P-type specimens given annealing treatment showed maxima in mobility for ⅓ and ⅔ Sb_2Te_3; this was interpreted as due to ordering of Sb in the lattice. A method of determining energy gap from thermoelectric power data is described. Values of 0.148 eV for Bi_2Te_3 and 0.1 eV for 25% Bi_2Te_3: 75% Sb_2Te_3 were obtained. Sb_2Te_3 is considered to have an energy gap ≈ 0.
C.H.L.Goodman

537.311.33

3463. RECTIFICATION, PHOTOCONDUCTIVITY, AND PHOTOVOLTAIC EFFECT IN SEMICONDUCTING DIAMOND.
M.D.Bell and W.J.Leivo.
Phys. Rev., Vol. 111, No. 5, 1227-31 (Sept. 1, 1958).

Studies of the rectification between a metal point and p-type semiconducting diamond show that the formation of the potential barrier is essentially independent of the work function of the metal. The rectifying barrier apparently is formed by the establishment of equilibrium between charges in surface and interior states as proposed by Bardeen for the case of silicon. The semiconducting diamonds are photoconducting in the ultraviolet and visible regions with the maxima occurring at 224, 228, 640, and 890 mμ. Generally, diamonds have not been observed to be photoconducting in the visible region; however, it has been observed that in some cases an enhancement of conductivity induced by u.v. radiation results upon simultaneous irradiation with red light. There is agreement between the spectral response of photoconductivity and photovoltages developed at metal contacts with the exception that photovoltages developed near 440 mμ were not obtained in photoconductivity.

537.311.33 : 539.21

3464. ELECTRON IRRADIATION OF P-N BLOCKING LAYERS IN GaAs. H.Pfister.
Z. Naturforsch., Vol. 12a, No. 3, 217-22 (1957). In German.

Measurements of the dependency of the short circuit current and e.m.f. on the intensity of the electron beams are described. With 45 kV-electrons the short circuit current was about 7200 times as large as the electron beam current and about 6.3 eV was expended by the incident electron to produce an electron hole pair. The efficiency for matched conditions was about 8% of the incident beam intensity. The application to electron diffraction patterns is discussed.
R.Stratton

537.311.33

3465. THE INFLUENCE OF IMPURITIES ON THE ELECTRICAL PROPERTIES OF GALLIUM ARSENIDE.
G.K.Averkieva and O.V.Emel'yanenko.
Zh. tekh. Fiz., Vol. 28, No. 9, 1945-7 (1958). In Russian.

Polycrystalline GaAs was prepared from its constituents in sealed silica tubes with a silica liner. Additions of 0.01 to 2 wt% were made of Cu, Zn, Cd, In, Si, Ge, Sn, Sb, S, Se and Te. Single crystal specimens could be cut from some ingots. The highest Hall mobility obtained (in undoped specimens with donor concentration of $\sim 10^{18}/cm^3$) was ~ 2500 cm^2/V sec. Cu, Zn and Cd acted as acceptors, S, Se and Te as donors. Zn was particularly effective giving 10^{20} carriers/cm^3.
C.H.L.Goodman

537.311.33 : 537.312.5

3466. A QUADRATIC PHOTOELECTROMAGNETIC EFFECT IN GERMANIUM.
M.Cardona and W.Paul.

J. Phys. Chem. Solids, Vol. 7, No. 2-3, 127-40 (Nov., 1958).

The quadratic photoelectromagnetic (P.E.M.) effect observed by Kikoin and Noskov in cuprite was observed in germanium and silicon. The effect occurs when the magnetic field B is rotated an angle ϕ about an axis lying in the illuminated face and perpendicular to the primitive direction of B. The linear effect is produced by the component $B\cos\phi$ of B, while the quadratic effect is produced by the action of $B\sin\phi$ on the electric current generated by $B\cos\phi$. From this elementary argument the quadratic P.E.M. effect should be proportional to $B^2 \sin\phi \cos\phi$. A part of the effect is produced by the action of a magnetic field on a current produced by the action of a magnetic field on the diffusion current of the injected carriers. Calculating this term, one finds the same type of average of the collision time as appears in the magnetoresistance coefficients. Consequently, the effect becomes anisotropic and, instead of being proportional to $B^2 \sin 2\phi$, is proportional to $B^2[\sin(2\phi + \Delta) + g]$, where Δ and g are functions of the constants of the semiconductor and the orientation of the sample. For certain simple orientations (such as the crystallographic axes) $\Delta = 0$ and $g = 0$. The ratio of the quadratic to the linear P.E.M. fields is, for small light intensities, a function only of the Hall angles, the magnetoresistance coefficients of electrons and holes, the impurity concentration, and the magnetic field. Agreement between theory and experiment is satisfactory.

537.311.33

3467. COMPARISON OF RADIO-COPPER AND HOLE CONCENTRATIONS IN GERMANIUM.
K.Wolfstirn and C.S.Fuller.

J. Phys. Chem. Solids, Vol. 7, No. 2-3, 141-5 (Nov., 1958).

The changes in carrier concentrations which occur when Cu^{64} is introduced into p- and n-type germanium containing known concentrations of gallium and arsenic were determined by resistivity measurements. The results for four different Cu^{64} concentrations indicate the presence of three ionization levels. Although the precise positions of the levels cannot be determined, graphical solutions employing the level scheme of Woodbury and Tyler (Abstr. 3273/1957) are shown to be reasonably consistent with the results.

537.311.33 : 535.343

3468. THE CONTRIBUTION OF FREE HOLES TO THE INFRARED ABSORPTION IN GERMANIUM.
R.Kessler.

Z. Naturforsch., Vol. 11a, No. 9, 763-5 (1956). In German.

The previously found discrepancy between theory and experiment (Abstr. 7412/1956) is almost completely removed when account is taken of the degenerate valence band structure.

R.Stratton

537.311.33

3469. ANOMALY OF CARRIER LIFETIME IN GERMANIUM BICRYSTALS.
H.F.Mataré and B.Reed.

Z. Naturforsch., Vol. 11a, No. 10, 876-8 (1956).

Bicrystals grown so that there is an angle of misfit of 20 or 25° between the two halves, show an anomalous result when the photo-voltage v. distance curves are measured across such a wide "grain boundary" using the Morton–Haynes method. In some cases the photo-voltage actually increases as the distance from the light spot or line increases. The phenomenon is interpreted with the aid of the dangling bond concept.

C.A.Hogarth

537.311.33

3470. INVESTIGATION OF THE PHOTO-MAGNETO-ELECTRIC EFFECT AS A METHOD FOR DETERMINATION OF THE BODY DIFFUSION LENGTH IN GERMANIUM.
S.G.Kalashnikov and E.G.Landsberg.

Zh. tekh. Fiz., Vol. 28, No. 7, 1387-93 (1958). In Russian.

The dependence of the photo-magneto-electric (P.M.E.) voltage on illuminance, length of the illuminated portion of the Ge specimen, and intensity of the magnetic field was investigated. Since no fringe effects were observed, it was concluded that although certain theoretical relationships were formulated for semi-infinite semiconductor slab they can be used for calculating the diffusion length L from experimental data obtained by simultaneous measurements of the P.M.E. effect and photoconductivity. L for a large number of Ge specimens was determined by this method, and the results were in satisfactory agreement with those obtained by other workers with the aid of the photo-electric method. It was shown, by studying the effect of the surface preparation of the Ge specimens on L, that when the method proposed by the authors is used, surface recombination can be eliminated. The method, applicable to both p-and n-type Ge, can be used for measuring very small L (≥ 0.03 mm even in heavily doped specimens, and does not require any complicated apparatus.

M.H.Sloboda

537.311.33

3471. INVESTIGATION OF THE EFFECT OF LOW ENERGY ELECTRONS ON THE P–N JUNCTION IN GERMANIUM.
U.B.Soltamov and E.S.Grishin.

Zh. tekh. Fiz., Vol. 28, No. 7, 1394-6 (1958). In Russian.

Several p–n junctions obtained by the thermal conversion method (Abstr. 4398/1956) were bombarded with low energy electrons (< 1000 eV), and the following relationships were determined: E/eU_p, i_2/i_1, α/eU_p and ϵ/eU_p where E = e.m.f. induced in the junction, eU_p = energy of the exciting electrons, i_2 = current induced in the junction to which a back-voltage $U_0 < 50$ V had been applied, i_1 = exciting electron current, $\alpha = i_2/i_1$, and ϵ = energy expended in formation of one hole–electron pair. The results reproduced graphically show that the effect of the low energy electrons on a Ge p–n junction is similar in character to that of other forms of radiation. However, owing to the comparatively small depth of penetration of the low energy electrons, surface recombination plays an important part, so that the magnitude of the induced phenomena is considerably affected by the surface conditions of the experimental specimens.

M.H.Sloboda

537.311.33

3472. THE DEPENDENCE OF THE HALL CONSTANT ON TEMPERATURE AND MAGNETIC FIELD STRENGTH IN P-TYPE GERMANIUM.
V.I.Stafeev and V.M.Tuchkevich.

Zh. tekh. Fiz., Vol. 28, No. 8, 1642-5 (1958). In Russian.

Several inadequacies of the simple isotropic theory were revealed by measurements of the Hall constant, R, for temperatures -180° to +170° C using magnetic fields, H, up to 22 kilogauss on specimens of ~ 50 ohm cm resistivity. R diminished with increasing H too rapidly; the temperature at which R vanished (~ 120° C) decreased with increasing H, instead of increasing; with increasing temperature R increased slowly, reaching a maximum before dropping through zero – this anomalous increase being more marked at low H (it is suggested that this might explain discrepancies in the Hall mobility of p-type Ge).

K.F.Hulme

537.311.33

3473. ON THE STATISTICS OF IMPURITY CENTRES WITH SEVERAL LEVELS IN GERMANIUM-TYPE SEMICONDUCTORS.
V.E.Khartsiev.

Zh. tekh. Fiz., Vol. 28, No. 8, 1651-6 (1958). In Russian.

Following a qualitative discussion of the energy levels of substitutional impurities in a tetrahedrally bonded semiconductor, the theory of their occupation is presented. The resulting expressions are too complex for analytic development, but no approximate treatment is attempted.

K.F.Hulme

537.311.33 : 539.21

RADIATION DAMAGE IN Ge AND Si DETECTED BY CARRIER LIFETIME CHANGES: DAMAGE THRESHOLDS. See Abstr. 2943

537.311.33

3474. SOME SEMICONDUCTING PROPERTIES OF HgTe.
J.Black, S.M.Ku and H.T.Minden.

J. Electrochem. Soc., Vol. 105, No. 12, 723-8 (Dec., 1958).

HgTe was synthesized and single crystals were prepared both in a horizontal capsule and by the Bridgman technique. The Hall coefficient R and the resistivity ρ were measured as a function of temperature and magnetic field. Above 250°K the material was intrinsic with an energy gap of around 0.02 eV and a mean density-of-states effective carrier mass of about 0.04 m_e. Hall effect and magnetoresistance data indicated that at 300°K $\mu_n \sim 16\,000$ $cm^2/(V\,sec)$ while $\mu_n/\mu_p \sim 10$. In the intrinsic temperature range, mobilities decreased with increasing temperature. At low temperatures R decreased markedly with magnetic induction even though R measured at low fields was independent of temperature for one of the ingots. In addition, the magnetoresistance fell far below a B^2 dependence at low temperatures. This behaviour is characteristic of p-type semiconductors in the transition temperature range between intrinsic and extrinsic conduction. In HgTe this transition temperature range is quite wide because of the low energy gap. Since all material prepared from the melt was p-type, it seems that there is either a dominating acceptor impurity in all the samples or the maximum melting point of the compound does not occur at the stoichiometric composition.

537.311.33

3475. ELECTRON MOBILITY IN InP.
M.Glisksman and K.Weiser.
J. Electrochem. Soc., Vol. 105, No. 12, 728-31 (Dec., 1958).

The Hall mobility of electrons in InP was observed as a function of temperature and of carrier concentration. A lattice mobility of 5000 $cm^2/(V\ sec)$ at 290°K is calculated from these results, varying with temperature at least as rapidly as T^{-2}. The observations can be interpreted by assuming a combination of lattice and ionized impurity scattering with an effective mass of the order of 0.05 m_0 or less.

537.311.33

3476. ELECTRICAL CONDUCTION IN P-TYPE InSb BETWEEN 100° AND 2°K. E.H.Putley.
Proc. Phys. Soc., Vol. 73, Pt 1, 128-31 (Jan., 1959).

Hall coefficient and conductivity were determined for several samples of two predominant types, having impurity centres at two different energy levels. Below 20°K impurity band conduction was observed, except in the purest sample, which continued to show valence band conduction to the lowest temperature.

K.W.Plessner

537.311.33 : 538.63

3477. AN OSCILLATORY TRANSVERSE MAGNETORESISTANCE EFFECT IN N-TYPE InSb. E.H.Putley.
Proc. Phys. Soc., Vol. 73, Pt 1, 131-3 (Jan., 1959).

The observations, made at 2° to 4°K, do not fit the characteristics of the de Hass—van Alphen effect, and an explanation has not been found. The possibility that the effect is due to the dislocation structure, by analogy with a similar effect in thin metal films, is examined and rejected. K.W.Plessner

537.311.33 : 538.63

3478. INTERPRETATION OF THE TRANSVERSE MAGNETORESISTANCE IN P-TYPE INDIUM ANTIMONIDE AT LIQUID NITROGEN TEMPERATURE. C.H.Champness.
Phys. Rev. Letters, Vol. 1, No. 12, 439-40 (Dec. 15, 1958).

The experimental results are explained using the concept of light plus heavy holes as in p-type germanium. C.A.Hogarth

537.311.33

3479. MOBILITY OF ELECTRONS AND HOLES IN PbS, PbSe, AND PbTe BETWEEN ROOM TEMPERATURE AND 4.2°K.
R.S.Allgaier and W.W.Scanlon.
Phys. Rev., Vol. 111, No. 4, 1029-37 (Aug. 15, 1958).

Hall coefficient and resistivity measurements were made on 29 single crystals (mostly synthetic) of PbS, PbSe, and PbTe between room temperature and 4.2°K. Almost all of the samples had extrinsic carrier concentrations of the order of 10^{18} per cm^3, as deduced from the Hall coefficients which were essentially constant over the entire temperature range investigated. Hall mobilities were calculated from the Hall and resistivity data, and were found to increase rapidly with decreasing temperature. Between room temperature and about 50°K the mobility behaviour was essentially intrinsic and varied approximately as $T^{-2.2}$. Below 50°K the mobility curves turned gradually toward the horizontal in a manner resembling the residual resistance phenomenon observed in metals. Values as high as 800 000 $cm^{-2}V^{-1}\ sec^{-1}$ were attained at 4.2°K despite the large carrier concentrations present in all the samples. A simple experiment was performed which suggests that dislocations are the principal scattering mechanism below 50°K, rather than the charged point defects associated with the extrinsic carriers. The possibility that a high static dielectric constant could explain the large mobilities at low temperatures is discussed.

537.311.33

3480. (A CONTRIBUTION TO) THE QUESTION OF THE MECHANISM OF CONDUCTION AND PHOTOCONDUCTION IN POLYCRYSTALLINE LAYERS OF SEMICONDUCTORS OF THE PbS GROUP. B.T.Kolomiets and V.N.Larichev.
Zh. tekh. Fiz., Vol. 28, No. 6, 1358-62 (1958). In Russian.

The influence of oxygen on conductivity, thermoelectric power, and photoconductivity of n-type evaporated layers of PbS, PbSe and PbTe is studied. Two effects are differentiated: surface adsorption at low temperatures (which may be reversible), and diffusional penetration (possibly of S, Se, or Te freed by reaction with the oxygen) at high temperatures. Only the latter appears to lead to high photosensitivity, which is ascribed to the formation of p—n junctions within the microcrystals of the layers. The observation of non-linear current : voltage characteristics for all three materials after exposure to oxygen at high temperatures is considered confirmation of this hypothesis. See also Abstr. 7895 (1951); 3769 (1955); 399, 2247 (1957); and 7022 (1958). C.H.L.Goodman

537.311.33

3481. THE TEMPERATURE VARIATION OF THE CONCENTRATION OF IMPURITY CARRIERS IN SILICON. E.H.Putley.
Proc. Phys. Soc., Vol. 72, Pt 5, 917-20 (Nov., 1958).

In a previous paper (Abstr. 7958/1958) the temperature variation of impurity carrier concentration was used to deduce the concentration of boron and phosphorus impurities in compensated silicon specimens, assuming that only the ground state of the impurity levels need be considered. Here it is shown that the results are modified if account is taken of the first excited state of phosphorus, and the boron ground state is assumed to have four-fold degeneracy.

C.Hilsum

537.311.33 : 538.633

3482. ON THE LOW TEMPERATURE BEHAVIOUR OF THE MAGNETORESISTANCE VARIATION OF SILICON SINGLE CRYSTALS. G.Finke and G.Lautz.
Z. Naturforsch., Vol. 11a, No. 12, 1011-15 (1956). In German.

An almost exponential increase of the transverse magnetoresistance with falling temperature, which was observed with pure crystals (room temperature resistivity = 90 ohm cm) in the liquid hydrogen range, could not be correlated with existing theory.

R.Stratton

537.311.33

3483. THE ELECTRICAL CONDUCTIVITY OF CARBORUNDUM AT HIGH TEMPERATURES. F.H.Constable and L.Feridun.
Rev. Fac. Sci. Univ. Istanbul C, Vol. 22, No. 3, 256-66 (July, 1957).

The presence of impurities leads to n-type or p-type conduction, depending on the valency of the impurity. The electrical resistance R of a polycrystalline sample of carborundum was measured at 1000 c/s over the range of temperatures from 1373 to 1723° A; log(1/R) plotted against 1/T, T being absolute temperature, gave an almost straight line, and it is concluded that the valency bond ionization potential is 2.34-0.00056 T eV. When direct current is used the resistance varies with time, and at 1465°C the curve fits an equation of type:

$$\text{conductivity} = \sum_{i=1}^{6} a_i e^{-b_i t}$$

This indicates the existence of six energy levels. N.Corcoran

537.311.33

3484. CONCERNING THE CONDUCTIVITY OF SEMICONDUCTING TIN DIOXIDE. B.P.Krȳzhanovskiĭ.
Zh. tekh. Fiz., Vol. 28, No. 7, 1489-80 (1958). In Russian.

The electrical conductivity of compressed powder specimens of SnO_2, prepared by the oxidation of SnO, ranged from 2.5×10^{-5} to $3 \times 10^{-7} ohm^{-1}cm^{-1}$ as the oxidation temperature was varied from 800°-1000°C; it was markedly increased on subsequent heating in vacuum. It is suggested that the presence of SnO and/or Sn in SnO_2 can explain these results, and that semiconducting tin oxide layers on glass must be considered in terms of the system Sn-SnO-SnO_2.

C.H.L.Goodman

537.311.33

3485. POLARIZATION STUDIES WITH THORIUM OXIDE.
W.E.Danforth.
J. Franklin Inst., Vol. 266, No. 6, 483-92 (Dec., 1958).

Detailed measurements of the initial rate of rise of polarization. An attempt is made to deduce therefrom the density of mobility of charge carriers. Existing theoretical papers on the subject are briefly discussed. Reasonable values of carrier density are obtained but mobility values appear to be too low and to vary with temperature in the wrong sense. Probe measurements show that, for values of time less than one minute, the development of polarization e.m.f. is confined to regions near the electrodes; for long times the polarization becomes more uniformly distributed throughout the crystal. Studies with constant voltage applied to a crystal show that, above a critical value of voltage, an instability develops in which the current increases to large values.

537.311.33

3486. PROPERTIES AND STRUCTURE OF TERNARY SEMICONDUCTING SYSTEMS. IV. ELECTRIC AND PHOTOELECTRIC PROPERTIES OF SUBSTITUTIONAL SOLID SOLUTIONS IN THE SYSTEM ZnTe—CdTe. B.T.Kolomiets and A.A.Mal'kova.
Zh. tekh. Fiz., Vol. 28, No. 8, 1662-9 (1958). In Russian.

For Pt III, see Abstr. 2238 (1957). Polycrystalline specimens were prepared by slow cooling (in sealed silica tubes) from 1300°C, with subsequent heat treatment for homogenization. Continuous solid solutions were formed, the lattice constant varying linearly with composition. All specimens were p-type, with conductivity increasing from ~ $7 \times 10^{-5} ohm^{-1}cm^{-1}$ for CdTe to ~ $7 \times 10^{-2} ohm^{-1}cm^{-1}$ for

ZnTe. Excess of Zn or Te had little effect on the latter value. Thermoelectric power and Hall effect were also determined, Hall mobilities in the range 5-45 $cm^2/Vsec$ being obtained. Photoconduction and optical transmission spectra were measured, the optical energy gap varying linearly with composition from 1.43 eV for CdTe to 2.1 eV for ZnTe. C.H.L.Goodman

537.311.33

3487. THE ELECTRICAL RESISTANCE OF OXIDE FILMS ON ZIRCONIUM IN RELATION TO CORROSION.

R.D.Misch and F.H.Gunzel, Jr.
J. Electrochem. Soc., Vol. 106, No. 1, 15-20 (Jan., 1959).

The conductivity of anodic and corrosion films on zirconium was found to increase during heating in vacuum. The conductivity changes at 450°C were studied on anodic films which were 0.6, 0.75, 0.9, and 1.5 μ in thickness. The change in conductivity was attributed to the diffusion of anion vacancies into the oxide with an estimated diffusion coefficient of 4×10^{-13} $cm^2 sec^{-1}$. Corrosion films produced in water at 350°C appeared to have higher diffusion coefficients. Among the materials zirconium, Zircaloy-1, and Zircaloy-2, specimens of zirconium had the highest corrosion rates and diffusivities (as judged by the conductivity changes). Consequently, an effect of vacuum heating on corrosion was expected and subsequently confirmed. Enhanced oxide growth was observed after corroded specimens were heated at 600°C for 1 min. The increase in weight gain was greater than would be expected from a simple restoration of dissolved oxide.

537.311.33

3488. STUDY ON ANNEALING OF RADIATION INDUCED 1/f NOISE IN Ge P–N JUNCTION. K.Komastubara and U.Hashimoto.

J. Phys. Soc. Japan, Vol. 13, No. 9, 1062 (Sept., 1958).

The short-circuit current noise of a transistor collector junction increases immediately after γ-irradiation, and then decreases to its original value after some days at 20°C. The recovery time at 95°C is only 1 hr. Changes in reverse current and the current gain are also studied, and a tentative explanation of the effect is given. C.Hilsum

537.311.33

3489. ON THE MECHANISM OF ELECTROLYTIC RECTIFICATION. P.Winkel and B.Verkerk.

Philips Res. Rep., Vol. 13, No. 6, 501-5 (Dec., 1958).

It is shown that electrolytic rectification can be considered as a process taking place uniformly across the surface layer.

537.311.33 : 621.383.8

3490. THE EFFECT OF RADIATION ON SILICON SOLAR-ENERGY CONVERTERS. J.J.Loferski and P.Rappaport.

R.C.A. Rev., Vol. 19, No. 4, 536-54 (Dec., 1958).

The performance of silicon solar cells under simultaneous illumination and irradiation by various ionizing radiations has been observed for the purpose of estimating the useful life of such power sources in earth satellites. Experiments were conducted both in air and in vacuum for 2 MeV electrons, 20 MeV protons and 40 MeV alpha-particles. The maximum power, open circuit voltage and short-circuit current experienced a decay. These results have been extrapolated to yield an estimated minimum of about 10^5 yr until the output of such cells on a satellite drops to 75% of the initial value. Possible modifications of these estimates based on tentative data acquired from satellite flights are considered. The decay of the cells is associated with changes in minority-carrier lifetime and deviations from expected behaviour are discussed. No definite decay was observed during the limited exposure time of this study for the ultraviolet radiation between 2200 A and 3400 A or for X-rays from machines operated at 50-2000 kV.

537.311.33

3491. ELECTRIC BREAKDOWN OF GERMANIUM P–N JUNCTIONS. C.Yamanaka and T.Suita.

Technol. Rep. Osaka Univ., Vol. 7, 241-51 (Oct., 1957).

Electric breakdown of Ge p–n junctions was studied at various temperatures using different forms of applied voltages. The mechanism of breakdown seems to be divided into two processes, i.e. thermal accumulation effect and ionization process. The directional effect of breakdown in p–n junction was also studied. The irradiation of γ-rays from Co^{60} has some influence on the breakdown voltage and the junction's characteristics.

537.311.33

3492. CRYSTAL RECTIFIERS AS RECEIVERS FOR THERMAL RADIATION IN THE REGION 100-1000 μ WAVELENGTH.

H.Happ, W.Eckhardt, L.Genzel, G.Sperling and R.Weber.
Z. Naturforsch., Vol. 12a, No. 6, 522-4 (1957). In German.

Silicon and germanium rectifiers are much used in the microwave region as detectors. The sensitivity of these rectifiers is shown to extend into the infrared region. The shape of the spectral sensitivity curve has some theoretical interest but more important is the use for such crystals as infrared receptors. R.W.Fish

537.311.33

3493. ON THE THEORY OF THE P–N JUNCTION WITH VANISHINGLY SMALL CARRIER LIFETIMES. O.Madelung.

Z. Naturforsch., Vol. 12a, No. 12, 1020-21 (1957). In German.

Using the fact that for vanishingly small lifetimes the product of majority and minority carrier densities is a constant (equal to the square of the intrinsic carrier density) throughout the barrier layer, the junction is treated like two metal–semiconductor contacts in series, the Schottky–Spenke analysis being applied with appropriate modifications to each. Expressions are given for the reverse and forward static characteristics, and some of their limitations briefly considered. F.F.Roberts

537.311.62

3494. THE QUANTUM THEORY OF THE HIGH FREQUENCY SURFACE IMPEDANCE OF A METAL. M.Ya.Azbel'.

J. Phys. Chem. Solids, Vol. 7, No. 2-3, 105-17 (Nov., 1958).

A quantum-mechanical formula is derived for the high-frequency surface impedance of a metal in a constant magnetic field of arbitrar direction. No special assumptions are made about the dispersion law of the conduction electrons. It is shown that in general, the relative amplitude of the quantized resistance oscillations is considerably greater than at zero frequency. In principle, an experimental determination of the magnetic field dependence of the impedance would be sufficient to determine the shape of the Fermi surface and the velocities of the electrons thereon.

537.311.62 : 539.2

SKIN EFFECT IN METALS UNDER CONDITIONS OF PARAMAGNETIC RESONANCE. See Abstr. 2938

537.312

3495. INDUCED CONDUCTIVITY OF METAL–SEMICONDUCTOR CONTACTS. S.D.Chatterjee and S.K.Sen.

Trans. Bose Res. Inst. Calcutta, Vol. 20, 161-76 (1955).

Modern theory is used to explain some old experimental results of Bose on the change in contact resistance due to incident electromagnetic radiation. D.M.Edwards

537.312.5 : 621.383

3496. THE PHOTOELECTRIC EFFECT AND ITS APPLICATIONS. [Der lichtelektrische Effekt und seine Anwendungen].

Edited by H.Simon and R.Suhrmann.
Berlin/Göttingen/Heidelberg: Springer Verlag (1958) xii + 747 pp.
In German.

This book is a second, revised, edition of the book "Lichtelektrische Zellen und ihre Anwendung". It is divided into several sections, contributed by various authors. A short introduction is followed by two sections on photoelectric emission and photoconduction (including photovoltaic effects) in relation to their fundamental aspects. The next section describes preparation techniques for photoelectric cells including purification methods for materials involved. This is followed by a description of production methods for the various photoconducting and photovoltaic devices. Secondary electron emission and its application in photoelectric multiplier tubes are next discussed. An important section deals with radiation measurement techniques using the various kinds of detectors inclusive of spectrophotometry. Later sections are concerned with such applications as those to photometry, image intensifiers, television and nuclear particle detection. References to the literature are given at the end of each section and a general index for all sections at the end of the text. There are ample diagrams and illustrations of devices and a collection of very useful data is tabulated in the various sections. G.F.J.Garlick

537.312.5

3497. DIFFUSION OF CHARGE CARRIERS IN PHOTOCONDUCTORS, TAKING INTO ACCOUNT THE LOCAL LEVELS. J.Auth.

Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 210-14 (1957). In German.

The diffusion equations are reduced to only one differential equation which, for a particular case, agrees with the continuity equation derived by van Roosbroeck (Abstr. 6778/1953). A model is suggested for an n-photoconductor, and the differential equations are solved for this model. It is found that the concentration decrease for the electrons is exponential. F.Lachman

537.312.5 : 537.226.8

3498. ON THE ELECTROSTATIC CHARGING OF CdS SINGLE CRYSTALS UNDER THE ACTION OF HIGH ELECTRIC FIELDS.

K.W.Böer and U.Kümmel.

Ann. Phys. (Leipzig), Folge 7, Vol. 2, No. 5-6, 217-24 (1958).
In German.

Both positive and negative charge accumulations were observed in crystals after a high current was passed through them. The dependence of this charge on the magnitude of the field and the frequency when a.c. fields were used (both in the dark and with weak illumination) and its independence of the nature of the electrode materials, can all be explained on the basis of a non-homogeneous bulk conductivity which also gives rise to dielectric (polarization) after effects. It is argued that the conduction process at high fields cannot be explained in terms of space-charge limited currents initiated by electron injection from the cathode as stated by Rose and Smith (Abstr. 4646/1955). R.Stratton

537.312.5

3499. DEMONSTRATION BY A MICROCALORIMETRIC METHOD OF A NEW PHENOMENON IN THE INTERIOR OF SELENIUM PHOTOCELLS.

D.Blet-Talbot.

C.R. Acad. Sci. (Paris), Vol. 247, No. 22, 1970-2 (Dec. 1, 1958).
In French.

Two identical photocells are attached respectively to the two junctions of a thermocouple and receive the same constant luminous flux. One photocell is an open circuit and the other is in series with a variable resistance R. The electrical power supplied by the second photocell to its external circuit and the change in temperature of the photocell are measured for each value of R. The results indicated that the luminous energy absorbed by the photocell was not used exclusively to heat the photocell or to produce the photoelectric current, but that a small fraction of the energy was used to modify the structure of the sensitive layer. S.Weintroub

537.312.5

3500. ORGANIC PHOTOCONDUCTORS. V. A MODEL FOR PHOTOCONDUCTIVITY IN CATIONIC DYES.

R.C.Nelson.

J. chem. Phys., Vol. 30, No. 2, 406-9 (Feb., 1959).

For Pt IV see Abstr. 8780 (1958). It is shown that there is a close relationship between the excited state associated with the lowest optical transition of the molecule in solution and that associated with photoconductivity in the solid dye. The model considers the solid dye as a periodic array of potential wells having discrete bands of allowed energies corresponding to the ground state and excited state of the molecule. In the case of dyes whose conductive properties are strongly temperature-dependent, it is assumed that an excited electron can move in the array by passing over the intermolecular barrier. Extension of this assumption to dyes in which the conductive properties depend only slightly on temperature leads to contradictions, and it is assumed in this case that electrons move through the array by tunnelling. It is shown that in such a system the diffusivity will be very large and the mobility very small, and that the Einstein diffusivity-mobility relationship does not hold. The model has properties which are in accord with those observed for the two classes of dyes.

537.312.5

3501. BEHAVIOR OF LEAD SULFIDE PHOTOCELLS IN THE ULTRAVIOLET.

A.Smith and D.Dutton.

J. Opt. Soc. Amer., Vol. 48, No. 12, 1007-9 (Dec., 1958).

Spectral response measurements were made on Eastman Kodak cells in the wavelength range 0.2-2.0 μ. The quantum sensitivity (defined as the number of electron charges passed in the external circuit per incident photon) is roughly constant for wavelengths greater than 0.6 μ, but rises linearly with photon energy at shorter wavelengths. The increase in quantum yield is attributed to electron multiplication by secondary internal emission.

537.312.5 : 535.371

3502. THE INTENSITY-DEPENDENCE OF PHOTOCONDUCTION AND LUMINESCENCE OF PHOTOCONDUCTORS IN THE STATIONARY STATE.

H.A.Klasens.

J. Phys. Chem. Solids, Vol. 7, No. 2-3, 175-200 (Nov., 1958).

The properties of photoconductors and photoconducting phosphors are determined by states in the forbidden zone. Two models are considered for discussing the intensity-dependence of photoconduction and luminescence photoconductors. In each model two recombination processes between electrons and holes are competing. It is shown that the one-state model, where direct recombination may take place between free electrons and free holes or via one impurity state, is generally not adequate. The two-state model with two discrete states having different capture cross-sections for capturing electrons and holes, can explain satisfactorily many aspects of photoconductors quantitatively, such as superlinearity of luminescence and photoconduction, changes in power from 1 to 0.5 in the conductivity versus intensity curves, activation and killing of phosphors, saturation etc. Duboc's method of considering all possible combinations between simplified versions of the equations describing the stationary state was applied successfully to the mathematical solution of the two-state model. Although there are 128 such combinations, all of which may occur under appropriate conditions, only a few occur in each individual case when only the intensity of excitation is varied. Others may appear when the temperature is varied. A few practical cases are analysed and the correct combinations of approximations determined. In particular two examples of superlinearity are studied in detail. It appears that the general features of the curves can in both cases be described adequately in terms of the model with two discrete states, without having to introduce energy distributions of "ground states", as proposed by Rose. However, a problem remains in that the range of light intensity over which superlinearity occurs is much greater than is predicted by the simple model; it is possible that this can be explained e.g. by the spatial distribution of photoconductive excitation through the sample, due to the absorption of the incident radiation.

537.312.5

3503. BISMUTH—TELLURIUM PHOTO-VOLTAIC P—N "SANDWICH".

T.Piwkowski.

Nature (London), Vol. 182, 1793-4 (Dec. 27, 1958).

Describes the construction of a sensitive layer which is made by evaporating Bi in vacuo and then a layer of Te, which partially overlaps it. Its action is discussed. C.A.Hogarth

537.312.5 : 535.345

3504. PHOTOEMISSIVE, PHOTOCONDUCTIVE, AND OPTICAL ABSORPTION STUDIES OF ALKALI-ANTIMONY COMPOUNDS.

W.E.Spicer.

Phys. Rev., Vol. 112, No. 1, 114-22 (Oct. 1, 1958).

By means of absorption and photoconductivity measurements, the following band gaps were found: Na_3Sb— 1.1 eV; K_3Sb—1.1 eV; Rb_3Sb—1.0 eV; Cs_3Sb—1.6 eV; and $(NaK)_3Sb$—1.0 eV. A model has been derived for the photoemission from these materials which fits the three last materials listed above in addition to the $(NaK)_3Sb$ with surface layers of Cs or Rb added. The electron affinities found from the photoemissive data using this model were as follows· Rb_3Sb—1.2 eV; Cs_3Sb—0.45 eV; $(NaK)_3Sb$—1.0 eV; $[Rb](NaK)_3Sb$—0.70 eV; and $[Cs](NaK)_3Sb$—0.55 eV. The electron affinity of K_3Sb was estimated to be between 1.1 and 1.8 eV and that of Na_3Sb to be between 2.0 and 2.4 eV. By means of the temperature dependence of the photoemission, Rb_3Sb, Cs_3Sb, and the multi-alkali materials were found to have p-type conductivity; whereas K_3Sb and Na_3Sb were found to have n-type conductivity.

537.312.5

3505. ON A CLASSIFICATION OF ORGANIC DYESTUFFS ON THE BASIS OF THEIR PHOTOELECTRIC CHARACTERISTICS.

H.Meier.

Z. wiss. Photogr., Vol. 53, No. 1-3, 1-18 (1958). In German.

It is shown that the effects of oxygen on the photocurrent in dyestuffs fall into two categories: that for dyes such as malachite green, fuschin, rhodamine, thiazine and oxazine, which are sensitized by oxygen; and that for dyes such as fluorescein, azo- and acridin dyes, which exhibit photoconduction in vacuo. By analogy with p- and n-type semiconductors, the differential action of oxygen can be explained. G.F.J.Garlick

537.312.62

3506. THE CRITICAL MAGNETIC FIELD OF RHENIUM AT 0.3°K.

J.Doulat, B.B.Goodman, A.Lacaze, M.Renard and L.Weil.

C.R. Acad. Sci. (Paris), Vol. 247, No. 3, 275-7 (July 21, 1958).
In French.

The critical magnetic field of a rhenium specimen was deduced from measurements of the magnetization of the specimen as a function of field. The measurements were made over a temperature range from 0.3°K to the transition temperature 1.698°K, and the critical field was found to be 198 ± 2 oersted. A.E.De Barr

537.312.62 : 538.245

3507. SUPERCONDUCTIVITY AND FERROMAGNETISM IN ISOMORPHOUS COMPOUNDS.

B.T.Matthias, E.Corenzwit and W.H.Zachariasen.

Phys. Rev., Vol. 112, No. 1, 89 (Oct. 1, 1958).

Isomorphous germanides of some of the rare earth metals are observed to become either ferromagnetic or superconducting. It is concluded that there is a close relationship between the two phenomena.

537.312.62

3508. ISOTOPE EFFECT ON THE SUPERCONDUCTING TRANSITION IN LEAD. R.R.Hake, D.E.Mapother and D.L.Decker.

Phys. Rev., Vol. 112, No. 5, 1522-32 (Dec. 1, 1958).

Observations of the difference in critical fields of superconducting Pb specimens of different isotopic mass are described. Measurements are made using the Meissner effect and a ballistic induction method in the range from 7.2 to about 1.4°K. The results near T_c verify the theoretical prediction that $T_c = \text{const} \times M^p$, where M is the average isotopic mass, and yield a value of $p = 0.501 \pm 0.013$. The measurements at lower temperatures are inconclusive in their implications for the isotope effect, since all specimens measured exhibit large deviations from the predictions of the similarity principle. The deviations are apparently not related to the isotopic mass of the specimens. The agency responsible for the observed deviations has not been isolated, but it is believed that the anomalous H_c values are characteristic of thermodynamically irreversible transitions. Thus the present results are not believed to constitute genuine evidence of a deviation from the similarity principle.

537.312.62

3509. RANDOM-PHASE APPROXIMATION IN THE THEORY OF SUPERCONDUCTIVITY. P.W.Anderson.

Phys. Rev., Vol. 112, No. 6, 1900-16 (Dec. 15, 1958).

A generalization of the random-phase approximation of the theory of Coulomb correlation energy is applied to the theory of superconductivity. With no further approximations it is shown that most of the elementary excitations have the Bardeen—Cooper—Schrieffer energy gap spectrum, but that there are collective excitations also. The most important of these are the longitudinal waves which have a velocity $v_F\{\frac{1}{3}[1-4N(0)|V|]\}^{\frac{1}{2}}$ in the neutral Fermi gas, and are essentially unperturbed plasma oscillations in the charged case. Other collective excitations resembling higher bound pair states may or may not exist but do not seriously affect the energy gap. The theory obeys the sum rules and is gauge invariant to an adequate degree throughout.

537.312.62

3510. THEORY OF THE MEISSNER EFFECT.

D.Pines and J.R.Schrieffer.

Phys. Rev. Letters, Vol. 1, No. 11, 407-8 (Dec. 1, 1958).

The problem of a gauge-invariant treatment of the Meissner effect is discussed, and Wentzel's treatment (Abstr. 1484/1959), which leads to a different penetration depth from the B.C.S. treatment, is shown to be invalid. R.G.Chambers

537.312.62

3511. PROBLEM OF GAUGE INVARIANCE IN THE THEORY OF THE MEISSNER EFFECT. G.Wentzel.

Phys. Rev. Letters, Vol. 2, No. 2, 33-4 (Jan. 15, 1959).

A reply to criticisms by Pines and Schrieffer (preceding abstract). R.G.Chambers

537.312.62 : 538.221

3512. FERROMAGNETIC SUPERCONDUCTORS.

B.T.Matthias, H.Suhl and E.Corenzwit.

Phys. Rev. Letters, Vol. 1, No. 12, 449-50 (Dec. 15, 1958).

It is pointed out that superconductivity and ferromagnetism might occur together in suitable solid solutions of the superconductor $CeRu_2$ and the ferromagnetics $PrRu_2$ or $GdRu_2$. In the first system $(Ce,Pr)Ru_2$, the overlap in properties would occur below 1°K and has yet to be observed. In the second system $(Ce,Gd)Ru_2$, the ferromagnetic Curie point and superconducting T_c would appear to coincide at a ratio Ce:Gd of 94 : 6 and a temperature of 3.6°K. Both transitions have been observed experimentally in a specimen with 8% $GdRu_2$; as the temperature is lowered in this case, the ferromagnetic transition precedes the superconducting, in which phase it is then believed that the sample never leaves the intermediate state.
L.Mackinnon

537.312.62 : 538.11

PROPAGATION OF A MAGNETIC FIELD INTO A SUPERCONDUCTOR. See Abstr. 2483

537.312.62 : 537.311.31

SUPERCONDUCTIVITY OF SOME URANIUM ALLOYS AND COMPOUNDS. See Abstr. 3432

537.312.8 : 539.2

3513. MAGNETORESISTANCE AND FERMI SURFACE OF ALKALI METALS. F.García-Moliner.

Proc. Phys. Soc., Vol. 72, Pt 6, 996-1000 (Dec., 1958).

The observed magnetoresistance effects in low fields are used for an approximate estimate of the anisotropy of the Fermi surfaces of alkali metals. The elements appear to be arranged in order of increasing anisotropy as follows: sodium, rubidium, potassium, caesium, lithium. The Fermi surface in sodium is almost spherical In lithium it is considerably anisotropic and it might even contact the Brillouin zone boundary.

537.312.9

3514. EFFECT OF ELONGATION ON THE ELECTRICAL RESISTIVITY OF METALS. I. ALUMINUM. II. MOLYBDENUM.

H.R.Peiffer.

J. appl. Phys., Vol. 29, No. 11, 1581-3, 1583-4 (Nov., 1958).

The changes in the electrical resistivity of metals at 78°K with elongation are investigated. Pt I is devoted to the changes introduced in the face-centred cubic metal aluminium upon elongation at 78°K. Pt II discusses the changes that occur in the body-centred cubic metal molybdenum upon elongation at 298°K. Both sections describes the relationship between the portion of the resistivity generally attributed to point defects and the resistivity that remains after the point-defect recovery has been completed; these resistivities are proportional to each other for both metals. It is noted that for both metals the resistivity caused by point defects and the residual resistivity are directly proportional to the elongation. It is further discovered that the rate of resistivity recovery at 145°C for cold-worked molybdenum is directly proportional to the amount of elongation introduced.

537.312.9

3515. PIEZORESISTANCE IN HEAVILY DOPED N-TYPE GERMANIUM. M.Pollak.

Phys. Rev., Vol. 111, No. 3, 798-802 (Aug. 1, 1958).

Measured as a function of temperature with donor concentrations between 6×10^{18} and 3×10^{19} cm^{-3}. The results obtained can be explained on the basis of the accepted multivalley model, provided that statistical degeneracy is taken into account. An analysis of the degeneracy observed in the data provides strong evidence for the four-ellipsoid model of the conduction band. The data are consistent with the assumption that there is no appreciable dependence of the effective mass, deformation potential constant, and mobility anisotropy factor on the Fermi level or impurity density. No piezoresistance effect due to the (100) valleys is detected, showing that these valleys are at least 0.11 eV above the minima of the (111) valleys.

537.312.9

3516. THE EFFECT OF STRAIN ON THE ELECTRICAL RESISTANCE OF KERATIN. J.E.Algie.

Textile res. J., Vol. 29, No. 1, 1-6 (Jan., 1959).

The change of resistance with time after the application of various strains has been examined at 90% R.H. and 20°C for keratin fibres. There is an initial instantaneous rise of resistance much greater than that due to a dimensional change, which is related to the strain, followed by a decrease in the resistance caused by the uptake of water vapour from the surrounding atmosphere. A further stage was observed during which the resistance rose as excess water vapour left the fibre.

537.312.9 : 538.27

CHANGES OF THE ELECTRICAL RESISTANCE OF IRON-NICKEL ALLOYS ON OMNIDIRECTIONAL COMPRESSION. See Abstr. 2516

537.321 : 621.362 : 621.311.25

3517. MULTIPLE STAGE THERMOELECTRIC GENERATION OF POWER. T.C.Harman.

J. appl. Phys., Vol. 29, No. 10, 1471-3 (Oct., 1958).

The efficiency equation for any number of thermoelectric generators thermally in series is derived. The design relationships for maximum efficiency and for maximum power transfer of a multiple stage thermoelectric generator are also given. Since the efficiencies are approximately additive, and appreciable increase in generator efficiency is anticipated by use of multiple stages.

537.321

3518. ON THE NOISE OF RADIATION THERMOCOUPLES.

U.Schley and F.Hoffmann.

Optik, Vol. 15, No. 6, 358-71 (June, 1958). In German.

Describes the measurement of thermal noise potentials for various thermocouples and the determination of the least measurable radiation intensities. The experimentally determined thermal noise potentials were found to be as a rule greater than those calculated from Nyquist's formula for the thermal noise of resistors. The noise potentials do not depend either on gas pressure inside the receiver casing or on the heat capacity of the receiving system or in the performance of thermocouples as radiation receivers. It is thought that the noise is due to the contact potential in the soldering oints. It was found that the maximum performance is associated with the highest sensitivity of thermocouples to radiation.

F.Lachman

537.322

519. STUDY OF THE THERMOELECTRIC E.M.F. OF MONOMETALLIC (THIN Ag/SOLID Ag) AND BIMETALLIC (THIN Ag/OLID Cu OR SOLID Ag/THIN Cu) COUPLES AS A FUNCTION OF HE THICKNESS OF THEIR SOLID BRANCHES. H.Benel.
ev. Fac. Sci. Univ. Istanbul C, Vol. 21, No. 4, 261-71 (Oct., 1956) n French.

See Abstr. 4386 (1957). The couples studied systematically rom 100 to 300°C were 57 mμ Ag/(44 to 447) mμ Ag; 58 mμ Ag/35 to 536) mμ Cu; and (35 to 402) mμ Ag/65 mμ Cu. For thickesses > 200 mμ and 240 mμ for Ag and Cu respectively the e.m.f. as independent of the thickness.

S.Weintroub

537.322

520. THERMOCOUPLES WITH CHEMICALLY DIFFERENT MULTIPLE LAYERS. H.Benel.
Rev. Fac. Sci. Univ. Istanbul C, Vol. 21, No. 4, 272-6 (Oct., 1956). n French.

See preceding abstract. The e.m.f. of a solid Ag/thin Ag film ouple decreases when alternate layers of Cu and Ag are deposited n the thin branch. It is considered that the effects due to the inhomogeneities produced by the layers, which have the same polarity relative to solid Ag, are additive. By depositing a sufficiently thick film of Cu on the solid branch of a solid Ag/thin Ag couple the e.m.f. can be reduced to zero.

S.Weintroub

537.322

521. COPPER LAYERS GIVING A NULL THERMO-E.M.F. OF A COUPLE CONSISTING OF THIN FILM SILVER/SOLID SILVER. VARIATION OF THERMO-E.M.F. OF A COUPLE CONSISTING OF THICK FILM SILVER/SOLID SILVER AS A FUNCTION OF THICKNESS OF THE COPPER LAYER DEPOSITED ON THE SOLID SILVER BRANCH. H.Benel.
Rev. Fac. Sci. Univ. Istanbul C, Vol. 22, No. 2, 117-23, 124-7 (April, 1957). In French.

Experiments are described which show that thin films of copper deposited on the solid silver side of the couple nullify the thermoelectric effects at particular (fairly low) temperatures. The effects are further investigated as a function of copper layer thickness.

C.A.Hogarth

537.323

3522. STUDY OF THE EFFECT OF TIME OF REHEATING ON THE THERMOELECTRIC POWER OF POLYCRYSTALLINE SELENIUM. D.Vidal and G.Blet.
C.R. Acad. Sci. (Paris), Vol. 247, No. 23, 2109-10 (Dec. 10, 1958). In French.

For 99.995% purity the thermoelectric power decreases slightly for tempering times of about 1 hr and then stays constant independent of further heat treatment. For 99% purity the thermoelectric power decreases approximately exponentially with increasing time of heat treatment, and tends to a value characteristic of the purer material.

C.A.Hogarth

537.323

3523. THERMOELECTRIC POWER OF DILUTE INDIUM—LEAD AND INDIUM—THALLIUM ALLOYS. W.J.Tomasch and J.R.Reitz.
Phys. Rev., Vol. 111, No. 3, 757-64 (Aug. 1, 1958).

Investigation of twenty-two indium—lead alloys and thirteen indium—thallium alloys. For the indium—lead alloys, the existence of structure at both 273°K and 77°K is reaffirmed. The thermoelectric power of the indium—thallium system is found to be an extremely smooth function of the composition in the same range of solute concentration. It is concluded that the observed structure in indium—lead is due exclusively to changes in electronic concentration brought about by alloying. An estimate of the pure electronic concentration contribution to the thermoelectric power is obtained by subtracting the indium—thallium data from the corresponding indium—lead data. The results of this procedure are demonstrated to be in qualitative agreement with the predictions of a band-model theory which is developed for this comparison. It is therefore suggested that the observed structure can be attributed to the extinction of bands of electron holes and the initiation of bands of overlap electrons. Definite suggestions are made concerning the band configuration of pure indium and the evolution of this configuration with alloying. A qualitative explanation is offered for the face-centred tetragonal (c/a > 1) to face-centred tetragonal (c/a < 1) phase transformation which occurs at the α-phase solubility limit.

537.323 : 537.311.33

THERMOELECTRIC POWER OF NON-POLAR SEMICONDUCTORS. See Abstr. 3451

537.363

3524. MECHANISM OF CATAPHORETIC SEGREGATION IN INERT GAS GLOW DISCHARGES. L.B.Loeb.
J. appl. Phys., Vol. 29, No. 9, 1369-71 (Sept., 1958).

The collection of a minority gas species at the cathode in a glow discharge, termed cataphoresis, appears not to have been completely successfully explained. Observation indicates that in all cases, the minority gas segregated at the cathode, must be capable of being very effectively ionized by the vehicular gas. The recent discovery of the effective creation of ion complexes such as $NeHe^+$ and NeA^+ in pressure dependent reactions above some mm of Hg pressure by Oskam, the independent direct observation of these ions and the production of ions such as HeH^+, NeH^+ and AH^+ with 1% H_2 in the inert gas by Weimer, using the effusion mass spectrometer of Pahl, render a basis for the extension of the Druyvesteyn theory developed for metallic ions in inert gas to the general process, aid in the explanation of the Hg-Xe anomaly observed by Kenty, and indicate certain needed corrections which are acting to make the process more efficient.

ELECTRIC DISCHARGES

537.52

3525. ELECTRICAL DISCHARGES. J.Dutton and E.Jones.
Nature (London), Vol. 183, 91-3 (Jan. 10, 1959).

Report on the Physical Society autumn conference on "Gas Discharges" held at the University College of Swansea in September, 1958. Brief summaries of some of the contributions concerned with fundamental processes, arc, spark, glow and h.f. discharges, transient discharges, collision processes and energy distributions, are given.

J.Dutton

537.521.6

3526. THE STRIKING POTENTIAL OF THE ANODE ARC. W.Merl.
Z. Naturforsch., Vol. 11a, No. 12, 1041-2 (1956). In German.

A discussion of the short arc which occurs between the electrodes of an electrical contact at small separation. Electrons are extracted from the cathode by field emission and the properties of the arc depend upon the electrode metal rather than upon the surrounding gas.

M.R.Hopkins

537.521.6

3527. INVESTIGATION OF THE ELECTRIC STRENGTH OF SOME COMPRESSED GASES AND GASEOUS MIXTURES USING AN ELECTROSTATIC GENERATOR. L.I.Pivovar and V.M.Tubaev.
Zh. tekh. Fiz., Vol. 28, No. 7, 1538-48 (1958). In Russian.

A compact electrostatic generator was used for studying breakdowns in CO_2, nitrogen, hydrogen, mixtures of nitrogen with CO_2, nitrogen with SF_6, and CO_2 with SF_6, at pressures from 1 to 10-14 atm. It is shown that: (i) the most suitable gas insulator for an electrostatic generator seems to be the mixture of nitrogen with SF_6 (at pressures up to 8 atm), or the mixture of CO_2 with SF_6 (at higher pressures); (ii) mixtures of nitrogen with CO_2 at pressures higher than 7-8 atm have greater electric strength than each component separately.

Z.Krasucki

537.523.4

3528. EFFECT OF HUMIDITY ON THE SPARK BREAKDOWN VOLTAGE. K.R.Allen and K.Phillips.
Nature (London), Vol. 183, 174-5 (Jan. 17, 1959).

Shows how the breakdown voltage for uniform field gaps in air (500 and 760 Hg pressure) depends on the vapour pressure of the water present. Data are presented graphically and compared with those of Köhrmann. The effect can amount to a breakdown voltage increase of several per cent for ~ 10 mm Hg water vapour, relative to dry air.

J.D.Craggs

537.523.4

3529. A SPECTROSCOPIC INVESTIGATION OF SHORT DURATION, HIGH CURRENT SPARKS IN HYDROGEN. P.Ravenhill.
Rep. Brit. Elect. Res. Assoc., Rep. L/T353, 12 pp. (1956).

Describes work done to determine the manner in which the radiation from a spark channel conducting 700 A in hydrogen is distributed in the spectrum and also the manner in which this spectral distribution varies with time both during the current pulse and in the afterglow of the hydrogen spark. The profiles of the hydrogen lines are plotted at various times throughout the discharge from which the decrement of the Balmer lines (i.e., the relative intensities of the spectral lines through the Balmer series) and the variation of the decrement with time are readily available. By the use of a special ultraviolet sensitive multiplier tube it has been possible to extend the measurements into the continuum below 3647 A (the Balmer series limit). From the results obtained it is possible to deduce the processes which are probably responsible for the light emission from the hydrogen channel, the ion concentration in the channel at various times and the electron temperature existing in the spark.

537.523.5

3530. ON THE INFLUENCE OF THE CONVECTION ON AN ARC. H.Rother.
Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 230-7 (1957). In German.

Theoretical computations of the shape, curvature and stability of convection stabilized horizontal-burning arcs are made, the basis of the theory being the direct integration of the convection-dependent Ellenbas—Heller differential equation, by means of a Green's function. It is shown that there is good agreement between theory and experiment for carbon arcs in air and for argon arcs.
J.Dutton

537.523.5 : 536.55

3531. THEORETICAL CALCULATION OF ARC TEMPERATURES IN DIFFERENT GASES. L.A.King.
Rep. Brit. Elect. Res. Assoc., Rep. G/XT155, 11 pp. (1957).

Consideration of the thermal conductivity of gases at high temperatures affords a background against which the physical characteristics of the low and high current arcs, and the transitions between them, can be understood. The negative slope of the k—T curves corresponding to the development of dissociation and ionization are shown to explain the formation of the successive cores of the high current and "supercontracted" arcs respectively. The importance of the effect of the power dissipated from the arc column on the transitions is emphasized, and the modifications caused by increased peripheral cooling, e.g. by axial gas blast, are demonstrated. The bearing of this work on spectroscopic sources is considered, since the transitions occur in very short period discharges ($< 10\mu$sec). It is suggested that the electric arc may be of use in the determination of molecular constants.

537.523.74

3532. TRANSIENT ANALYSIS OF THE TOWNSEND DISCHARGE. P.L.Auer.
Phys. Rev., Vol. 111, No. 3, 671-82 (Aug. 1, 1958).

The transient growth of currents in a one-dimensional Townsend gas discharge system under uniform d.c. field conditions is examined. It is shown that a general solution for arbitrary external conditions can be given in terms of a "unit pulse" solution. Two cases are examined in detail: in one case the discharge is initiated by a single pulse from the cathode, in the other the discharge develops under constant external illumination of the cathode. Expressions are derived which permit reasonably rapid calculation of quantities pertinent to the transient characterization of the discharge. For the two cases considered in detail, numerical illustrations are given and comparison is made with the results of other investigators.

537.525 : 537.56

3533. DYNAMIC STABILITY OF A SELF-PINCHED DISCHARGE. H.W.Wyld, Jr.
J. appl. Phys., Vol. 29, No. 10, 1460-5 (Oct., 1958).

The stability of a rapidly contracting self-pinched discharge (fast pinch effect) is studied using three different models for the plasma dynamics: (a) the free-particle model; (b) the snowplow model; (c) the shock-wave model. For each model the growth in time of a small perturbation on a time-dependent unperturbed solution of the equations of motion is obtained. It is shown that the free-particle model and the shock-wave model predict instabilities. The instabilities are rather mild, the instability times being of the order of the pinch time itself. The snowplow model predicts stability for the initial stages of the pinch, although instabilities probably develop later on.

537.525 : 621.387.032.213.13

3534. DISCHARGE MODES USING THERMIONIC CATHODES. R.B.Cairns and G.C.McCullagh.
J. Electronics and Control, Vol. 6, No. 1, 65-9 (Jan., 1959).

New observations have been made on the structure of discharges from hot cathodes and the relation between different forms, and information obtained about the roles of diffusion and oscillations.

537.52

3535. THEORY OF THE CATHODE SHEATH IN A LOW-DENSIT GAS DISCHARGE. P.L.Auer, H.Hurwitz, Jr and S.Tamor.
Phys. Rev., Vol. 111, No. 4, 1017-28 (Aug. 15, 1958).

The space-charge equations of a low-density gas discharge are derived and applied in the present report to the study of potential distributions in the cathode sheath. In order to facilitate mathematical computation, the contribution of secondary electrons and charg exchange to the potential distribution is neglected. The space-char is generated, consequently, by the primary electrons of the hot cathode and the ions resulting from volume ionization of the gas in the sheath. The effect of arbitrary positive-ion currents issuing from the positive column to the sheath is also examined. A self-consistent method of solution of the space-charge equations is employed in the present investigation. The method essentially involves finding a cross-section which corresponds to a particular potential distribution. A number of cross-sections of physical significance can be obtained by this method. The results of numerical calculations allow certain semi-quantitative conclusions to be drawn about the mode of evolution of a cathode sheath and positive colun with increasing gas pressure and applied voltage. An important conclusion of these calculations is that a positive column will begin to evolve when the number of ionization mean free paths in the discharge gap is of the same order as the square root of the ratio of electron to positive-ion mass.

537.525 : 621.317.32 : 621.372.821.1

3536. APPLICATION OF THE STARK EFFECT IN AN ALTERNATING FIELD FOR MEASURING ELECTRIC FIELDS IN A DISCHARG AT ULTRA-HIGH FREQUENCIES. V.E.Mitsuk.
Zh. tekh. Fiz., Vol. 28, No. 6, 1316-25 (1958). In Russian.

It is shown that the half-width of the H_β line of hydrogen depend almost linearly on the amplitude of the applied alternating field (9400 Mc/s). The broadening of the H_β line was used for measuring the electric fields in the plasma of hydrogen discharge. This metho can be used for measuring electric fields in waveguides in those cases where other methods are unacceptable.
Z.Krasucki

537.525.8

3537. GENERATION OF MOVING STRIATIONS AT A GAS ANODE J.R.M.Coulter, N.H.K.Armstrong and K.G.Emeleus.
Physica, Vol. 24, No. 10, 828-30 (Oct., 1958).

Results are described showing how the form of positive column wave which appears as a moving striation can be generated by a growing relaxation oscillation of the equivalent of an anode spot.

537.527.3

3538. EXPERIMENTAL STUDY OF D.C. CORONA AT HIGH TEMPERATURES AND PRESSURES. J.B.Thomas and E.Wong.
J. appl. Phys., Vol. 29, No. 8, 1226-30 (Aug., 1958).

Positive and negative corona characteristics of air and nitrogen are determined experimentally for coaxial cylindrical electrode geometry with gas temperatures from 300°K to 1100°K and with pressures from 0.1 to 8 atm. Over this range, positive corona characteristics appear to be functions of gas density only. On the other hand, negative corona characteristics depend on gas temperature as well as gas density. At high temperatures both positive and negative coronas show instabilities which are pressure dependent.

537.528

3539. FLUCTUATIONS IN A DISCHARGE CHANNEL. A.S.Zingerman and D.A.Kaplan.
Zh. tekh. Fiz., Vol. 28, No. 6, 1267-74 (1958). In Russian.

A study was made of short duration discharges between point—plane electrodes separated by a distance of several microns or tens of microns and immersed in an insulating oil. Under certain conditions small voltage fluctuations were observed in the arc. The fluctuations are brought about by processes taking place at the cathode and their presence depends on the magnitude of current and the material of the cathode. The fluctuations in the discharge channel can be explained on the basis of the mechanism of very short arcs (see Abstr. 3352/1948, 1771/1950).
Z.Krasucki

537.529 : 539.21

3540. THE EFFECTS OF γ-RAY IRRADIATION ON THE DIELECTRIC STRENGTH OF KCl. Y.Inuishi, Y.K.Sung and T.Suita.
Technol. Rep. Osaka Univ., Vol. 7, 235-40 (Oct., 1957).

Effects of γ-ray irradiation from Co^{60} on the electric strength of KCl single crystals were studied. The d.c. breakdown strength of KCl in the dark increases with increasing pre-irradiation of γ-ray or increasing colouration, the d.c. breakdown strength under isible light illumination, on the contrary, decreases with increasing rradiation. The impulse breakdown strength is not affected by pre-rradiation. From these facts anomalous changes in d.c. breakdown trength of KCl by γ-ray irradiation are ascribed to the space charge f trapped electrons at imperfections which works to increase break-own strength in the dark, and the positive space charge of ionized -centres in front of cathode which decreases breakdown strength. -centre density and lattice constant were measured for various -ray dosages.

537.529 : 621.315.616.9

541. TEMPERATURE DEPENDENCE OF ELECTRIC TRENGTH OF POLYTETRAFLUOROETHYLENE. .E.Balȳgin and K.S.Porovskiĭ.

h. tekh. Fiz., Vol. 28, No. 8, 1679-83 (1958). In Russian.

A study was made of the dependence of breakdown strength of olytetrafluoroethylene on temperature and thickness. In the range of emperatures from 25 to 300°C, the breakdown strength decreases ith increasing temperature both for d.c. and a.c. (50 c/s) voltages. ith d.c. voltages, the breakdown strength increases with increasing hickness (number of layers) of the dielectric; the rate of increase ecreases with increasing temperature. The breakdown strength ecreases with increasing area of the dielectric. With a.c. voltages, s the thickness of the dielectric is increased the breakdown strength ncreases to a steady value. Z.Krasucki

X-RAYS

537.531 : 535.33

542. TECHNIQUE FOR OBTAINING ABSORPTION AND MISSION SPECTRA OF X-RAYS. C.Kurylenko.

ahiers de Phys., Vol. 11, 223-37 (June, 1957). In French.

The history of the discovery of X-rays and their general roperties is recalled, and several types of X-ray generator are escribed. A.R.Stokes

537.531 : 535.34

3543. COMMENTS ON THE K-ABSORPTION SPECTRUM FOR -RAYS OF THE OXIDE Al_2O_3 (CORUNDUM TYPE). C.Kurylenko.

ahiers de Phys., Vol. 12, No. 93-94, 237-9 (May-June, 1958). n French.

The K absorption edge is displaced towards the lower wave-lengths. It is suggested that the true absorption edge is masked by a further absorption arising from Bragg-reflected ejected electrons. A.R.Stokes

537.531

3544. BROAD BEAM ATTENUATION IN CONCRETE FOR 50 TO 300 kVp X-RAYS AND IN LEAD FOR 300 kVp X-RAYS. E.D.Trout, J.P.Kelley and A.C.Lucas.

Radiology, Vol. 72, No. 1, 62-7 (Jan., 1959).

Collection of data including diagrams and graphs.

537.531 : 621.386.2

3545. INPUT LIMIT OF ANTICATHODE-MATERIAL IN X-RAY TUBE. T.Watanabe.

Sci. Rep. Tohoku Univ. First Ser., Vol. 40, No. 1, 24-31 (Aug., 1956).

A relation is obtained between the input limit and the thickness of an anticathode. The input limit of the substance used as an anticathode is calculated as a function of the thickness and the bombarded area.

537.531 : 535.345 : 539.17

THE NUCLEAR ABSORPTION OF X-RAYS BY OXYGEN. See Abstr. 2811

ELECTRON EMISSION . ELECTRON BEAMS

537.533

3546. WORK FUNCTION AND SORPTION PROPERTIES OF SILICON CRYSTALS. J.A.Dillon,Jr and H.E.Farnsworth.

J. appl. Phys., Vol. 29, No. 8, 1195-202 (Aug., 1958).

The work functions of silicon single crystals were obtained by measuring the contact potential differences between the crystals and a gold reference whose work function was measured by the Fowler method. The measurements were carried out in high vacuum ($p < 10^{-9}$ mm Hg). For nonfloating-zone silicon, the work function was higher for samples which were radiation quenched from 990°C than it was for samples which were annealed at 500°C. This effect was not observed for floating-zone material and was presumably a function of occluded oxygen. The work functions for the different faces after ion-bombardment cleaning were in the sequence $(100) > (110) > (111)$. The values after quenching were: (100), 4.92 eV; (110), 4.89 eV; (111), 4.77 eV. The values after annealing were: (100), 4.82 eV; (110), 4.70 eV; (111), 4.67 eV. The work function of the (111) face of a 2000 ohm cm, p-type, floating-zone sample was 4.73 eV after quenching or annealing. Changes in both surface and volume properties were observed when silicon was heated above 1000°C in contact with quartz. Oxygen exposures of 5×10^{-5} mm Hg min resulted in work function increases which were larger on the annealed surfaces than on the quenched ones. This was observed for both floating-zone and oxygen-doped material and is therefore a property of the silicon itself. Photoelectric evidence indicated a diffusion of oxygen into the silicon (1) when silicon was heated in oxygen, (2) when silicon was heated at 990°C in high vacuum after O_2 adsorption, and (3) when silicon with residual surface films from chemical etching was heated at 990°C prior to ion bombardment. Hydrogen exposures of 7.5×10^{-4} mm Hg min resulted in work-function decreases only in the presence of a heated filament. Nitrogen exposures of 4×10^{-6} mm Hg min resulted in no work-function changes. Heating silicon in high vacuum at 990°C for about 100 hr developed thermal-etch patterns which were rectangular on the (100) face, hexagonal on the (100) face, and triangular on the (111) face. Heating at 1080°C for 24 hours caused further etching which developed the same triangular patterns on the (111) face but left the (100) and (110) faces with a sandblasted appearance.

537.533.2 : 537.58

3547. THE WORK FUNCTION OF THIN FILMS OF THORIUM OXIDE AND THORIUM ON TUNGSTEN. A.R.Shul'man.

Zh. tekh. Fiz., Vol. 28, No. 8, 1711-3 (1958). In Russian.

The thermionic emissions of films of various thicknesses were analysed in terms of the Richardson–Dushman equation. ThO_2 films about a monolayer thick behaved like thoriated tungsten (the ThO_2 being reduced to Th), films a few atom layers thick like Th, and thicker films like ThO_2. Similar results were previously obtained for ThO_2 films on Mo (A.R.Shul'man and A.P.Rumyanstev, Zh. tekh. Fiz., Vol. 25, No. 11, 1898, 1955). K.F.Hulme

537.533.2

3548. THE WORK FUNCTION OF ANTIMONY–CAESIUM CATHODES. G.A.Zheludeva.

Radiotekhnika i Elektronika, Vol. 3, No. 3, 395-9 (1958). In Russian.

The dependence of the work function, as calculated from Einstein's equation, upon the wavelength of the incident light is investigated for antimony–caesium photocathodes. The work function is found to remain constant in the spectral region from 2200 to 5791 A. The question of the "red" limit of the cathodes is discussed. R.C.Glass

537.533.2

3549. "COLD ELECTRON EMISSION" AFTER ACTIVATION BY GLOW DISCHARGE. H.Drost.

Exper. Tech. der Phys., Vol. 6, No. 6, 258-71 (1958). In German.

The "exo-electron" emission yield and decay with time are investigated for various metals previously subjected to a glow discharge with the metal as cathode. Differences between the various metals occur in relation to discharge intensity and duration. The results are explained by using known semiconductor models. G.F.J.Garlick

537.533.2 : 537.58

3550. EFFECT OF A MAGNETIC FIELD ON THERMIONIC EMISSION FROM MOLYBDENUM. J.Greenburg.

Phys. Rev., Vol. 112, No. 6, 1898-900 (Dec. 15, 1958).

An experiment that was performed to explore the possible effect of an external magnetic field on thermionic emission from a clean metal surface demonstrated that an applied field of 6000 gauss or less has no effect on the saturation current density. The purpose of this study was to resolve, if possible, the disagreement between the work of Shelton and that of Nottingham and Hutson on the energy distribution of thermionically emitted electrons.

537.533.2 : 537.58

3551. THE EFFECT OF ELECTRIC FIELD IN THE CATHODE ON ITS ELECTRON EMISSION. S.M.Levitin.

Zh. tekh. Fiz., Vol. 28, No. 8, 1714-16 (1958). In Russian.

The "through" current passing through the cathode sets up an electric field in it [S.M.Levitin, Zh. tekh. Fiz., Vol. 23, No. 10, 1700

(1953)]. This field gives rise to an increase in the temperature of the electron gas and thus leads to an increase in electron emission.
Z.Krasucki

537.533.2
3552. MULTI-ALKALI PHOTO CATHODES. A.H.Sommer.
I.R.E. Trans Nuclear Sci., Vol. NS-3, No. 4, 8-12 (Nov., 1956).

The quantum efficiency of a photoemitting material is determined by a combination of physical properties. It has been found that the requirements are met best by semiconductors of low work function surfaces. In the light of these general considerations, a short survey is given of the photocathodes available heretofore. A description is given of multi-alkali cathodes, particularly those of the composition of Sb—K—Na and Sb—K—Na—Cs. Their advantages for use in scintillation counters are discussed.

537.533.2 : 537.311.33
3553. THE INFLUENCE OF DEFECT LEVELS ON PHOTOEMISSION. W.E.Spicer.
R.C.A. Rev., Vol. 19, No. 4, 555-63 (Dec., 1958).

The influence of defect levels on the characteristics of photoemitters is considered. These levels may affect a photoemitter through: (1) the creation of photoemissive centres; (2) the production of a bending of the bands at the semiconductor—vacuum interface and the semiconductor—backing interface; (3) the determination of the magnitude of thermionic emission from, and the conductivity of, the photoemitter. It is shown that, if photoemission from the valence band is to be used, the photoemitter performance will be optimized by acceptor levels near the top of the valence band. If photoemission from defect levels is desired, these should lie near the bottom of the conduction band. However, quantum efficiency in excess of a few per cent cannot be expected from defect levels.

537.533.2
3554. SOLUTION TO THE EQUATIONS OF SPACE-CHARGE FLOW BY THE METHOD OF THE SEPARATION OF VARIABLES.
P.T.Kirstein and G.S.Kino.
J. appl. Phys., Vol, 29, No. 12, 1758-67 (Dec., 1958).

The equations for irrotational, electrostatic laminar space-charge (no thermal velocities or normal magnetic field at the cathode) are set up in terms of the action function. The resulting nonlinear partial differential equation is first reduced, by the method of the separation of variables in cylindrical polar coordinates, to the solution of a set of first-order, nonlinear, ordinary differential equations in one coordinate. It is shown that it is possible to predict axially symmetric, electrostatic, hollow beams from the inside of hollow cylindrical cathodes with space-charge-limited emission which asymptote, theoretically, to other extremely thin cylinders — though thermal velocities would, in practice, limit such a convergence. The characteristics of a particular beam, and the electrode system to produce it are shown. The beams which result from the separation of variables in other coordinate systems are described. In spherical polar coordinates one obtains hollow axially symmetric beams from a conical cathode, which may asymptote to other cones; in a less familiar coordinate system, spiral coordinates, sheet beams from equiangular spiral cathodes result. It is shown how the method may be extended to include magnetic fields transverse to the cathode. Some new solutions to space-charge flow in crossed electric and magnetic fields from a space-charge-limited cathode are mentioned.

537.533.2 : 621.385.833
3555. THE NON-EXISTENCE OF STRAIGHT, PARALLEL COMPRESSIBLE SPACE-CHARGE FLOW. O.Buneman.
J. Electronics and Control, Vol. 5, No. 6, 561-2 (Dec., 1958).

For background see Abstr. 2394 (1959). The present note shows that straight-parallel flow cannot depend on the longitudinal coordinate at all and must therefore be incompressible, whatever its (irrotational) origin.
A.H.W.Beck

537.533.2 : 621.385.833
3556. SINGLE COMPONENT RELATIVISTIC SPACE-CHARGE FLOW. R.J.Lomax.
J. Electronics and Control, Vol. 5, No. 6, 563-4 (Dec., 1958).

See also preceding abstract. The work of Lucas (see Abstr. 2394/1959) is generalized to single component flow in any orthogonal coordinate system.
A.H.W.Beck

537.533.2 : 621.385.833
3557. ON SPACE CHARGE WAVES. D.H.Trevena.
J. Electronics and Control, Vol. 6, No. 1, 50-64 (Jan., 1959).

The existence is shown of four sets of space-charge waves on a uniform electron beam focused by an axial magnetic field with arbitrary, but uniform cathode flux. The magnetic field affects the results only through the cathode flux. Expressions for the plasma frequenc reduction figures are given. Some discussion is given for the case of a beam in a propagating drift tube.

537.533.
3558. SURFACE WAVES ON AN ELECTRON BEAM IN THE PRESENCE OF A MAGNETIC FIELD. G.Mourier
C.R. Acad. Sci. (Paris), Vol. 247, No. 22, 1978-80 (Dec. 1, 1958). In French.

It is stated that in crossed fields a surface wave associated with a perturbation, with phase velocity

$$v_1 = \frac{u_1}{1 + \omega_2^2/\omega\omega_C}$$

and negative energy, and another with phase velocity

$$v_2 = \frac{u_2}{1 - \omega_2^2/\omega\omega_C}$$

and positive energy below the surface, are coupled and can lead to gain (u_1 is the velocity of beam electrons above the beam surface, u_2 the velocity below the beam surface, ω_2 the plasma, ω_C the cyclotron, and ω the perturbation angular frequency). The coupling at synchronism is discussed qualitatively.
H.Motz

537.533.2 : 621.385.833
3559. THE EFFECT OF THE INCLINATION OF THE FOCUSING ELECTRODES ON ELECTRON BEAM FORMATION. R.J.Lomax.
J. Electronics and Control, Vol. 6, No. 1, 39-49 (Jan., 1959).

The behaviour of an electron gun in which the Pierce electrodes meet the cathode at an angle differing from $(90 + 67\frac{1}{2})^\circ$ is investigated. The beam edge no longer emerges normally from the cathode and the current density at the periphery of the cathode is found to depend critically on the electrode angle, in agreement with previous experimental results.

537.533.2 : 537.311.33
3560. PHOTOELECTRONIC EMISSION FROM MERCURY SELENIDE. O.M.Sorokin.
Zh. tekh. Fiz., Vol. 28, No. 7, 1413-23 (1958). In Russian.

Ultraviolet excited electron emission was studied with n-type polycrystalline disks and evaporated layers. The long-wave limit was at $h\nu \sim 4.45$ eV (yield $< 10^{-8}$ electrons/quantum). Volt—ampere characteristics were sensitive to heat treatment in liquid Hg or air. Evaporated films became p-type on heating in vacuo. It is suggested that excess Hg in HgSe acts as a donor (cf. Cs in Cs_2Te, Abstr. 2460/1953). An energy level scheme is presented which includes an energy gap of ~ 0.70 eV and a valence band to vacuum separation of ~ 5.15 eV.
C.H.L.Goodman

537.533.2 : 537.311.33
3561. THE PHOTOELECTRIC AND SECONDARY ELECTRON EMISSION OF GERMANIUM. P.G.Borzyak and O.G.Sarbeĭ.
Zh. tekh. Fiz., Vol. 28, No. 9, 1905-12 (1958). In Russian.

The spectral distributions of photoelectric emission of evaporated W and Ge films covered with various thicknesses of evaporated BaO were measured, and the results analysed by the method of Fowler. The work functions of Ge and W could be reduced to 1.8 and 1.9 eV, respectively, by optimum layers of BaO. The coefficients of secondary electron emission of Ge and Ta covered with BaO films were also studied as a function of primary electron energy and BaO film thickness; the coefficient of Ge could be increased four times by a suitable BaO film. Although Ge—BaO has the same work function as Cs_3Sb, and both are semiconductors, the latter is a superior electron emitter. This fact is discussed in terms of the band structure of the two solids, and it is concluded that the rate of loss of energy for excited electrons is higher in Ge than Cs_3Sb.
K.F.Hulme

537.533.2 : 621.383.7
3562. ON A PHOTOMULTIPLIER WITH CONTROLLABLE CATHODE SURFACE (AREA). W.Hartmann.
Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 247-9 (1957). In German.

It is pointed out that the dark-current, mainly due to thermionic emission, can be reduced by electron optical control of the area used, as well as by normal techniques such as cooling. In many circumstances, including photometry, measurements on small, focused light beams are required and in these cases, the technique proposed can improve the signal/noise ratio very greatly.
A.H.W.Beck

537.533.2

563. EMISSION OF SLOW SECONDARY ELECTRONS. .M.Anderson.
Nature (London), Vol. 183, 241-2 (Jan. 24, 1959).

A qualitative explanation in favour of co-operative interaction between the primary electron and the solid plasma is advanced for certain phenomena observed in secondary electron emission, viz. the existence of slow secondary electrons of about 1 eV energy, nearly independent of target and bombardment conditions; secondary emission within 2×10^{-10} sec of the primary impact; and the increase of the secondary coefficient to a maximum, and then its decrease, as the primary energy is increased. C.H.B.Mee

537.533.2

564. INVESTIGATION OF SECONDARY EMISSION FROM APERTURES. B.G.Butkevich and M.M.Butslov.
Radiotekhnika i Elektronika, Vol. 3, No. 3, 355-70 (1958). In Russian.

The chief characteristics of secondary electron emission from apertures covered by aluminium foil and foils coated with MgO are investigated. An experimental arrangement is described which enables measurements to be made of the energy distribution of the secondary electrons and their angle of emission while preventing any reverse current from the collector. A quantitative relation is established between the fast and slow secondary electrons for various foil thicknesses and accelerating voltages and the energy and angular distribution is shown. R.C.Glass

537.533.2

3565. KINETIC EJECTION OF ELECTRONS FROM TUNGSTEN BY CESIUM AND LITHIUM IONS. P.M.Waters.
Phys. Rev., Vol. 111, No. 4, 1053-61 (Aug. 15, 1958).

The total yield and the kinetic-energy distribution were measured for electrons ejected from both atomically clean and gas-covered tungsten surfaces by impact of Li^+ and Cs^+ in the kinetic-energy range 150 to 1500 eV. The results indicate that the probability of kinetic emission becomes vanishingly small, $\sim 10^{-6}$, in the vicinity of 150 eV ion kinetic energy and increases to 6.2×10^{-2} and 1.2×10^{-2} at 1500 eV for Li^+ and Cs^+, respectively, when the tungsten surface is atomically clean. The adsorption of a monolayer of either O_2 or N_2 increases the efficiency of this process by at least an order of magnitude below 350 eV ion energy, and by a factor of 2 or 3 at energies above some 500 eV. In addition, it was observed that the energy distribution of the electrons ejected does not change significantly as the result of such adsorption. An attempt to measure the probability of formation of Li^- from Li^+ striking an atomically clean tungsten surface showed that such a process, if it occurs at all, occurs with a probability less than about 2×10^{-8} for Li^+ incident with 150 to 1500 eV kinetic energy, while negative ions of undetermined constituency were observed to be formed with a probability of about 2×10^{-3} under the same conditions when the tungsten surface was thoroughly contaminated.

537.533.3

3566. ON THE FORM OF THE FACES OF A MAGNETIC SECTOR WITH HOMOGENEOUS FIELD AND THE CORRECTION OF APERTURE ABERRATION. A.Septier.
C.R. Acad. Sci. (Paris), Vol. 247, No. 19, 1577-80 (Nov. 10, 1958). In French.

For the deflection of low energy particles, the field of conventional magnetic deflecting sectors ends effectively at planes parallel to the mechanical surfaces. For the deflection of high energy particles the geometrical arrangement is such that the field ends effectively on curved surfaces, leading to material aberration. This can be corrected by curving the mechanical faces of the sector to a calculable degree. A.E.I. Research Laboratory

537.533.3

3567. CONCERNING THE NATURE OF THE ABERRATIONS IN ELECTRON SHEET BEAMS. W.E.Waters.
J. Opt. Soc. Amer., Vol. 49, No. 3, 304-7 (March, 1959).

A power-series expansion is used to derive expressions for the aberrations up to the third order in electron sheet beams, subject to purely electrostatic focusing. The "ray axis" is considered to be curvilinear in general. Chromatic effects are considered but space-charge is omitted. The treatment reveals the presence of four purely geometric aberrations and four others due to chromatic effects. No attempt is made to derive expressions for the aberration coefficients.

537.533.3

3568. ON THE ELECTRON-OPTICAL PROPERTIES OF POINTED CATHODES. S.Maruse and Y.Sakaki.
Optik, Vol. 15, No. 8, 485-91 (Aug., 1958). In German.

Describes various forms of pointed cathode assemblies for electron microscopes, discusses their performance and shows a photograph (× 32 000) of MoO_3 taken with such a cathode. At high field strengths field emission from the point is important, but at lower fields thermionic emission may be predominant. J.D.Craggs

537.533.332

3569. A METHOD OF MEASURING THE INDUCTION AND ITS DERIVATIVES ON THE AXIS OF MAGNETIC ELECTRON LENSES. P.Durandeau, B.Fagot and M.Laudet.
C.R. Acad. Sci. (Paris), Vol. 247, No. 25, 2316-18 (Dec. 22, 1958). In French.

A method is described of measuring the axial field strength and its derivatives along the axis of a magnetic electron lens. The accuracy of the method (0.1%) is limited by the accuracy with which the flux can be determined and not by the finite dimensions of the search coil. T.Mulvey

537.533.35

3570. AN ELECTRON MICROSCOPE WITH PROVISION FOR MICRO-DIFFRACTION AND FOR DARK-FIELD IMAGING BY MEANS OF AN INDIVIDUAL DIFFRACTED BEAM. W.D.Riecke and E.Ruska.
Z. wiss. Mikroskop. Vol. 63, No. 5, 288-302 (June, 1957). In German.

The Siemens electron microscope (Type UM 100) was modified for microdiffraction by replacing the usual projector lens with a simpler projector and an intermediate lens. The latter can be aligned by lateral shifts and is fitted with a stigmator for correcting axial astigmatism. An adjustable aperture in front of the intermediate lens allows a small area of the primary image produced by the objective to be selected for microdiffraction investigation. A "wobble-coil" is situated above the selector aperture to facilitate the focusing of the intermediate lens on its plane. At the normal magnification of ×28 000, the primary image falls exactly in the plane of the aperture and fields as small as 1 μ in diameter can be selected. A method is given for routinely checking the equivalent diffraction camera length, which is approximately 420 mm. A type of dark field imaging is obtained by moving the objective aperture off the axis until it selects a particular diffracted beam. V.E.Cosslett

537.533.7 : 536.581.3

CRYOSTAT FOR ELECTRON BOMBARDMENT AND ELECTRON DIFFRACTION WORK. See Abstr. 3405

537.533.73

3571. COMBINATION OF AN ELECTRON EMISSION MICROSCOPE WITH A REFLECTION DIFFRACTION CAMERA. R.Arnal.
C.R. Acad. Sci. (Paris), Vol. 247, No. 23, 2110-13 (Dec. 10, 1958). In French.

A reflection electron diffraction camera is described in which the secondary electrons, emitted by the specimen as a result of the primary bombarding electrons, are used to form an image of the specimen. This is done by placing an immersion objective near the specimen with the optical axis at right angles to the plane of the specimen. With this arrangement the area responsible for a particular diffraction pattern may be observed directly. A.E.I. Research Laboratory

537.533.73

3572. ELECTRON DIFFRACTION AT VERY HIGH VOLTAGE. R.Papoular.
Cahiers de Phys., Vol. 11, 202-16 (May, 1957). In French.

A diffraction camera is described which can operate with electron energies as high as 1.2 MeV. A linear accelerator is used as a source of high energy electrons. Examples of diffraction patterns at 600 and 900 keV are given. Some difficulties are referred to. A.E.I. Research Laboratory

537.533.73 : 539.2

3573. APPLICATIONS OF ELECTRON DIFFRACTION TO THE STUDY OF POLYMER STRUCTURE. P.Corradini and I.W.Bassi.
Ricerca sci., Vol. 28, No. 7, 1435-43 (July, 1958). In Italian.

The unit cell dimensions of isotactic poly-α-butene, isotactic polystyrene and syndiotactic 1-2-polybutadiene are derived. A.R.Stokes

537.533.75 : 535.376

3574. LUMINESCENCE PHOTOMETRY MEASUREMENTS OF THE ENERGY ABSORPTION IN THE RADIATION FIELD OF ELECTRON SOURCES. ONE DIMENSIONAL CASE IN AIR. A.E.Grün.
Z. Naturforsch., Vol. 12a, No. 2, 89-95 (1957). In German.

The luminescence excited was taken as a measure of the energy absorption when a collimated beam of electrons was directed through apertures into an air chamber. The light was measured for narrow sections of the absorbing gas perpendicular to the axis of the entering beam. The form of the curves was little dependent on the primary energy between 5 and 54 keV, while the depth of penetration was closely proportional to the 1.75 power of this energy. Calculated values for the loss of energy with depth showed good agreement with Bethe's theory. S.T.Henderson

ION EMISSION . ION BEAMS

537.534

3575. ON THE IMAGE FORCE OF IONIZED AND POLARIZED ATOMS. F.Kirchner and H.Kirchner.
Z. Natursforsch., Vol. 11a, No. 9, 718-23 (1956). In German.

Continuation of previous work (Abstr. 8050/1955) on the emission, under the influence of strong electric fields, of ionized atoms adsorbed on metal surfaces. Experiment shows that the field strength required to cause emission is greater the smaller the radius of the adsorbed atom in the case of Mg, Rb and Ag adsorbed on W, in agreement with the view that the image force of the adsorbed ions plays an important role. Measurements showing appreciable ion currents in Rb vapour at low fields $\sim 5 \times 10^6$ V/cm indicate that the image force of polarized atoms is also important. J.Dutton

537.534

3576. A HIGH CURRENT PROTON SOURCE.
P.C.Thonemann and E.R.Harrison.
Atomic Energy Res. Establ. (Harwell), Rep. GP/R1190, 8 pp. (1958).

The source is capable of delivering 10 mA of protons in a focused beam for injection into a linear accelerator.

537.534.3

3577. ALLOWED AND FORBIDDEN REGIONS FOR THE MOTION OF ELECTRICALLY CHARGED PARTICLES IN AXIALLY SYMMETRICAL MAGNETIC FIELDS. H.Fisser and R.Kippenhahn.
Z. Naturforsch., Vol. 14a, No. 1, 37-46 (Jan., 1959). In German.

The motion of charged particles in a rotationally symmetric magnetic field is characterized by their kinetic energy and generalized angular momentum. If these quantities are used as coordinates to define a plane, the boundaries between allowed and forbidden orbits are clearly seen. This is of particular value in considering the loss of particles from a region in which circular currents flow.
A.E.I. Research Laboratory

537.534.3

3578. INVESTIGATION OF THE ION-OPTICAL PROPERTIES OF THE SECTOR ELECTROSTATIC FIELD OF THE DISPERSIVE TYPE. M.I.Korsunskiĭ and V.A.Bazakutsa.
Zh. tekh. Fiz., Vol. 28, No. 7, 1510-25 (1958). In Russian.

An electrostatic analyser of the sector type has been built, but using curved walls instead of the usual cylinders. The focusing properties of such an analyser have been investigated theoretically and experimentally. The instrument has been applied to the spectral analysis of a beam of charged particles. T.Mulvey

537.534.3

3579. REFLECTION IMAGE CONVERTER FOR CORPUSCULAR BEAMS. G.Möllenstedt and W.Hubig.
Optik, Vol. 15, No. 4, 225-41 (April, 1958). In German.

An ion (or electron) microscope forms a primary image on a polished and effectively structureless beryllium plate. The secondary electrons ejected from this plate, which acts as cathode in a 45 kV immersion objective, form the final image on a screen back along the axis of the microscope; the primary beam passes through a small hole in this screen. Images obtained with a 50 kV lithium ion microscope are shown, the initial magnification being 63 and the secondary 49, a total of 3100 times; reproduction is at 13 600 times and the resolving power is estimated at 80 A when an aperture stop and stigmator are employed. The converter overcomes two difficulties in operating the normal ion microscope: damage to the viewing screen by ion bombardment, and low image brightness. The exposure time is reduced by 20 times in the new system. When the primary image is produced by electrons, the initial magnification is 89 x, the image is photographed at 5500 x and test micrographs are shown at 26 000 x. So far an intensification ratio of between 1 and 2 only has been obtainable with electrons, possibly owing to poor vacuum. Figures 6 and 11 have the captions interchanged.
V.E.Cosslet

537.534.3

3580. TRANSMISSION IMAGE CONVERTER FOR CORPUSCULAR RADIATIONS. W.Hubig.
Optik, Vol. 15, No. 9, 538-49 (Sept., 1958). In German.

The back-reflection image converter for electron and ion images (see preceding abstract) has been converted to transmission operation. The primary image falls on a foil of metal (or metallized collodion) situated in the central electrode of an electrostatic unipotential lens, which thus acts as an immersion objective for the secondary electrons emitted from the far side of the foil and focuses them into the final image. Both the primary and secondary magnification is of order 50 times, giving a direct magnification of 2000--4000 x. The converter foil first used was of aluminium, 1-5 μ thick, but better definition was obtained with a collodion foil, 1500--2000 A thick, on the rear side of which a layer of silver 700 A thick was evaporated. Images have been obtained with lithium ions and with electrons as primary radiation. With ions, the exposure time was 2 sec. at a direct magnification of 2200, but the electron exposure time is not given; no intensification factor has been estimated.
V.E.Cosslett

537.534.3

3581. A MASS SPECTROMETER OF SECOND ORDER FOCUSING. M.Yokota, M.Nagatani and I.Nonaka.
Mem. Fac. Sci. Kyusyu Univ. B, Vol. 2, No. 1, 22-31 (March, 1956).

Detailed account of construction and circuitry, also some performance data, of a symmetrical mass-spectrometer.
B.Meltzer

537.534.3

3582. A MODIFIED MASS SPECTROMETER ION SOURCE FOR THE STUDY OF SOLID SAMPLES. G.A.Heath and R.M.Hobson.
J. sci. Instrum., Vol. 35, No. 11, 429-30 (Nov., 1958).

An arrangement is described for converting a mass spectrometer for the examination of vapours from alkali halides. A small oven is used to produce the vapour. The oven can be refilled without dismantling the source. A.E.I. Research Laboratory

537.534.9 : 539.211

ION-BOMBARDMENT CLEANING METHOD. See Abstr. 2944

PARTICLE ACCELERATORS

537.54

3583. AN F.F.A.G. SYNCHROTRON WITH STRAIGHT SECTIONS HAVING ACCEPTABLE BETATRON OSCILLATIONS.
R.Taylor and M.J.Mitchell.
Atomic Energy Res. Establ. (Harwell) Rep. T/R2495, 16 pp. (1958).

A method of inserting radially-cut straight sections in an F.F.A.G. machine is presented, which reduces the effects of the resultant lack of scaling on the particle dynamics. General considerations concerning the superperiod structures of such machines are discussed, and possible design parameters are given, on the basis of computed orbits, for a 15 GeV machine.

537.54

3584. PHASE MOTION IN A SYNCHRONOUS ACCELERATOR WITH TILTED ACCELERATING GAP. R.Klíma.
Czech. J. Phys., Vol. 8, No. 4, 404-10 (1958).

A theory of phase motion in a synchronous circular accelerator is derived for the case in which, in addition to the accelerating component of a high-frequency field, a component acts on a particle which deforms the path of the particle. For an accelerator with constant period of revolution and fixed magnetic field, the result is asymptotic focusing of the particles to a certain phase ψ_s.

537.54

3585. SPACE-CHARGE EFFECTS IN ELECTRON-SYNCHROTRONS. C.Bernardini.
Nuovo Cimento, Vol. 10, No. 5, 804-16 (Dec. 1, 1958).

Space-charge effects are considered (taking into account positive ions) with the aim of deciding whether they can set up serious intensity limitations for the beams of weak focusing electron synchrotrons, or not. The possibility of linear resonances and non-linear beam splitting is shown. An estimate of the rate of production of positive ions in the doughnut is given.

537.54 : 621.384.611.3

3586. BEAM EXTRACTION IN THE MICROTRON. H.Reich.
Z. Naturforsch., Vol. 13a, No. 11, 1003 (Nov., 1958). In German.

A method of extracting the electron beam is described in which a single fixed exit canal is used regardless of beam energy. This is done by allowing the beam to pass through an iron cylinder, whose position is adjusted according to the energy of the beam.

A.E.I. Research Laboratory

537.54 : 615.849.1

3587. INVESTIGATIONS OF HIGH ENERGY ELECTRON BEAMS FOR USE IN THERAPY. G.W.Dolphin, N.H.Gale and A.L.Bradshaw.
Brit. J. Radiol., Vol. 32, 13-17 (Jan., 1959).

Measurements on the 14 MeV electron beam from the linear accelerator at St. Bartholomew's Hospital (London) are described. Details are given of the energy spectrum, current and size of the electron beam produced by the linear accelerator. The data about scattering the electron beam to obtain large fields suitable for electron therapy are given. Results are also given of measurements of the distribution and energy of electrons in a water phantom, with a brief account of the method of Perspex dosimetry.

537.54

3588. THE PARTICLE ACCELERATION INSTALLATION OF THE INSTITUT FÜR RADIUMFORSCHUNG.
T.Matitsch, R.W.Waniek and H.Warhanek.
S.B. Osterr. Akad. Wiss. mat.-nat. Kl. Abt. II, Vol. 165, No. 5-7, 273-80 (1956). In German.

A proton accelerator of classical design is described using a direct voltage of 200 kV. The equipment has been used for neutron production using a D—D or D—T reaction.

A.E.I. Research Laboratory

537.54

3589. PRODUCTION OF HIGH DENSITY PROTON CURRENTS FOR COLLIDING BEAM ACCELERATORS AT 15 GeV.
J.W.Burren, D.Morgan and W.Walkinshaw.
Atomic Energy Res. Establ. (Harwell) Rep.T/R2519, 28 pp. (1958).

A head-on collision of two 15 GeV protons produces an energy in the centre of mass equivalent to about 500 GeV with the target at rest. To achieve significant production of secondaries, intense beams of particles are required, and this is obtained by "stacking" successive pulses of particles at high energy. Limitations imposed by the accelerating system are examined and upper limits are given to the densities that can be obtained under different assumptions.

537.543 : 621.384.612

3590. THE OPTICAL DESIGN OF BEAM MATCHING SYSTEMS.
T.R.Walsh.
Atomic Energy Res. Establ. (Harwell) Rep. A/R2711, 8 pp. (1958).

Beam-matching is considered with reference to beams which may be represented by ellipses in phase space. A general expression for the profile of such beams is obtained and used to examine the parameters of a single-lens system. Extension of the treatment to more complex systems is discussed.

IONIZATION . PLASMA

537.56

3591. STATISTICAL DERIVATION OF THE DISPERSION FORMULA OF A LORENTZ PLASMA OF FINITE TEMPERATURE.
K.Rawer and K.Suchy.
Ann. Phys. (Leipzig), Folge 7, Vol. 2, No. 5-6, 313-25 (1958).
In German.

Extends and solves the Boltzmann equation for electrons by taking into account a previously neglected term to obtain a dispersion equation for three types of broadening.

C.G.Morgan

537.56

3592. CALCULATION OF THE EFFECTIVE IONIZATION VOLTAGE IN PLASMAS. H.Rother.
Ann. Phys. (Leipzig), Folge 7, Vol. 2, No. 5-6, 326-8 (1958).
In German.

Derives an expression for the lowering of the ionization voltage resulting from impact ionization by electrons. The relevant quantum number as a function of particle density agrees satisfactorily with experimental values.

C.G.Morgan

537.56 : 538.53

3593. THE INSTABILITIES OF A CYLINDRICAL GAS DISCHARGE WITH FIELD PENETRATION. J.Hubbard.
Atomic Energy Res. Establ. (Harwell) Rep. T/R2668, 17 pp. (1958).

Describes a calculation of the stability with field penetration, in which the effects of finite conductivity and viscosity are approximately taken into account. A wide range of field configurations was investigated.

537.56

3594. THEORETICAL STUDY OF THE ELECTRON DISTRIBUTION IN A HETEROGENEOUS AND ANISOTROPIC LORENTZIAN PLASMA. R.Jancel and T.Kahan.
J. Phys. Radium, Vol. 20, No. 1, 35-42 (Jan., 1959). In French.

The authors use a general expansion in spherical harmonics for the electron distribution function to obtain a solution of the transport equation for a weakly ionized inhomogeneous (existence of density gradient) and anisotropic plasma (in the presence of electric and magnetic fields). This solution gives rise to a system of differential equations, and the solution of this system of equations gives the first two approximations to the distribution function.

537.56 : 538.3

3595. A NOTE ON THE CONFINEMENT OF A PLASMA BY R.F. FIELDS. E.S.Weibel.
J. Electronics and Control, Vol. 5, No. 5, 435-8 (Nov., 1958).

Similar results have been reached by different methods by Boot et al (Abstr. 5069/1958) and by Weibel, ("The Plasma in a Magnetic Field", Papers of the Magneto-hydrodynamics Symposium, Dec. 1957, Palo Alto. Stanford University Press, 1958, pp. 60-76). Assumptions and approximations in the former derivation are criticized, and the difficulties of plasma confinement emphasized.

D.Walsh

537.56

3596. AN INVESTIGATION ON PLASMAS IN EXTERNAL MAGNETIC FIELDS. II. VARYING FIELDS. G.Schmidt.
Nuovo Cimento, Vol. 10, No. 4, 659-74 (Nov. 16, 1958).

The behaviour of a plasma placed in a varying-external magnetic field is investigated considering two limiting cases: (1) the ideal hydromagnetic ($\sigma \to \infty$); (2) the collisionless one. Restricting the calculations to general cylindrical geometries ($\partial/\partial z = 0$) and quasi-stationary processes, a complete set of plasma equations are obtained for both cases. These include among others equations of state also for the tenuous plasma. There is a close resemblance between the two sets of equations referring to completely different physical conditions. The equations can be readily solved to express every macroscopic plasma quantity in terms of the external magnetic field strength. The extension of these considerations to non-quasi-stationary processes is briefly depicted. It leads to a phenomenon which suggests new ways for the increase of plasma temperatures. For Pt I, see Abstr. 2431 (1959).

537.56

3597. PENETRATION OF A MAGNETIC FIELD INTO A ONE DIMENSIONAL PLASMA. A.Ron.
Nuovo Cimento, Vol. 10, No. 5, 844-53 (Dec. 1, 1958).

In connection with the proposed compression and heating of a plasma through the application of an external magnetic field arises the problem of the penetration of such a field into a plasma. It is here investigated how an external magnetic field penetrates into a one dimensional bounded plasma which behaves as a compressible hydromagnetic fluid whose conductivity is proportional to density. The resulting mathematical problem is complicated, in particular as the movement of the boundary is not known beforehand. Transformation to a system of coordinates moving with the fluid simplifies the equations. In particular, in the case of a slowly varying magnetic field a single equation obtains with the magnetic field as the only independent variable.

537.56

3598. MICROWAVE INVESTIGATION OF DISINTEGRATING GASEOUS DISCHARGE PLASMAS. H.J.Oskam.
Philips Res. Rep., Vol. 13, No. 5, 401-57 (Oct., 1958).

See Abstr. 1549 (1959).

537.56

3599. THEORETICAL STRUCTURE OF PLASMA EQUATIONS.
M.N.Rosenbluth and N.Rostoker.
Phys. of Fluids, Vol. 2, No. 1, 23-30 (Jan.-Feb., 1959).

In high-temperature plasmas, collisions are very infrequent. Thus the charged particles travel on independent orbits determined, by the electromagnetic field. At first sight this would seem completely different from a conventional fluid where particles are closely hemmed in by their neighbours. However, there can exist collective modes of motion in which the particles interact with each other by altering the fields. In this paper a new method is developed for the solution of the linearized transport equation. By facilitating direct use of the properties of particle orbits, a considerable simplification is achieved. In particular, a variational expression is derived for determining stability which is rigorous in the limits of small Larmor radius.

537.56

3600. ON THE CONFINEMENT OF PLASMA BY MAGNETOSTATIC FIELDS. E.S.Weibel.
Phys. of Fluids, Vol. 2, No. 1, 52-6 (Jan.-Feb., 1959).

The plasma is treated as an assembly of classical particles having masses m_+ and m_- and charges ±e. It is shown that if such a plasma is in thermodynamic equilibrium it is unaffected by a magnetostatic field. In particular, it cannot be confined by a magnetostatic field and at the same time be in equilibrium. In absence of collisions there exist stationary solutions for the magnetic field and the particle distribution in phase space such that the gas is confined. The solutions are self-consistent, meaning that the particle motions generate the field, which in turn maintains the particle distribution. However, this distribution may not be Maxwellian. As an example the linear pinch is treated. The fields, the particle number densities, and the current density are calculated for one particular case.

537.56

3601. OHMIC HEATING IN THE B-1 STELLARATOR.
W.Bernstein and A.Z.Kranz.
Phys. of Fluids, Vol. 2, No. 1, 57-61 (Jan.-Feb., 1959).

A detailed comparison between experimental data and the predictions of ohmic heating theory is made over a wide range of axial magnetic confining field, electric heating field, and helium pressure. It is found that, in the early stages of the discharge, agreement between theory and experiment is good, and the predicted scaling laws are valid. However, experimentally it is found that it takes about 5 times longer to complete first ionization than predicted. Also, the current is seen to level off at a plateau at a time when theory predicts a continuous heating. These discrepancies are attributed to three energy sinks: cold neutral particles entering the discharge, runaway electrons leaving the discharge, and radiation from impurities. In addition, the electron density is observed to decrease during the length of the discharge (pump-out). For the early current plateau observed at low ratios of heating field to pressure, it appears that the plasma density is about 15% less at 18 000 gauss than at 27 000 gauss as a result of this pump-out. The hydromagnetic instability predicted by Kruskal and previously demonstrated to exist is given the physical characteristics of an increased rate of diffusion.

537.56

3602. PLASMA POLARIZATION AND CARRIER INTERACTION.
G.Ecker and K.G.Müller.
Z. Phys., Vol. 153, No. 3, 317-30 (1958). In German.

The applicability of the Debye—Hückel theory to a plasma is discussed, and limits are given as follows:

$$z_i z_j e^2/kTr \ll 1 \quad \text{(Onsager—Kirkwood relation)}$$

$$\delta = (kT)^{3/2}/12\, e^3\sqrt{2\pi n} \gg 1$$

For the calculation of a probability distribution for the field a separation into individual particle and collective components is carried out. It turns out that only the fraction of the individual interaction energy is important, which shows correlation to the field at the origin. This leads to differences between neutral and charged particle results. Distributions for values of δ between zero and infinity are deduced and evaluated numerically.

H.Motz

537.56

3603. ON THE QUESTION OF THE ACCELERATION OF A PLASMA IN A MAGNETIC FIELD. G.V.Gordeev and A.I.Gubanov.
Zh. tekh. Fiz., Vol. 28, No. 9, 2046-54 (1958). In Russian.

The plasma is contained between two coaxial cylindrical electrodes at different potentials. An external magnetic field interacts with the resulting current, thereby rotating the plasma. The steady state velocity and temperature fields are calculated for the case when the mean free path is less than both the electron Larmor radius and the electrode separation, using the approximation that the viscosity and heat conductivity are constant. The power require to maintain the motion is calculated. Supersonic plasma motions could be produced under realizable experimental conditions.

O.Penrose

537.56 : 532.5 : 538.3

NON-LINEAR HYDROMAGNETIC SHOCK WAVES IN A COLD PLASMA. See Abstr. 2522

537.56 : 538.566.2

MICROWAVE PROPAGATION IN HOT MAGNETO-PLASMAS. See Abstr. 2541

537.56 : 538.566.2

PROPAGATION OF LONG ELECTRIC WAVES IN A MAGNETIZED PLASMA. See Abstr. 2544

537.562

3604. MASS SPECTROMETRIC ANALYSIS. MOLECULAR REARRANGEMENTS. F.W.McLafferty.
Analyt. Chem., Vol. 31, No. 1, 82-7 (Jan., 1959).

Structure determination by mass spectrometry has been hampered by the relatively unpredictable possibilities of molecular rearrangement. Classification of such anomalies as more random or more specific rearrangements is proposed. The former appear to involve a higher energy reshuffling process in which various atoms or groups are equilibrated in the molecule. The latter can yield either specific ions of high abundance through formation of a sterically favourable transition state or more stable products. Further classification according to whether the ions and neutral species involved contain an odd or even number of electrons has been useful in correlating these rearrangements. Mechanisms are proposed for several rearrangement classifications.

537.562

3605. THE IONIZATION PRODUCED BY BEAMS OF CARBON AND NITROGEN IONS. W.E.Burcham and M.A.F.Alves.
Proc. Phys. Soc., Vol. 72, Pt 3, 462-6 (Sept., 1958).

A study of ionization produced by carbon and nitrogen ions, of up to 80 MeV energy, in argon. Experimental data agree well with theory except for higher beam energies. The theory is semi-empirical in certain respects, but its relevance to other published work is discussed.

J.D.Craggs

537.563

3606. IONS IN NITROGEN. M.Saporoschenko.
Phys. Rev., Vol. 111, No. 6, 1550-3 (Sept. 15, 1958).

N^+, N_2^+, N_3^+, and N_4^+ ions were identified in nitrogen gas by use of a mass spectrometer operated with the ion source in the pressure range from 10^{-3} mm Hg to 0.6 mm Hg. Appearance potentials occur at 15.5 ± 0.2 eV for N_2^+, at 15.8 ± 0.3 eV for N_4^+, at 22.1 ± 0.5 eV for N_3^+, and at 24.2 ± 0.4 eV for N^+; N_3^+ ions thus are formed only at much higher electron energies than N_2^+ but still at 2 eV less energy than N^+. It is believed that the N_4^+ is formed by the process $N_2^+ + N_2 \rightarrow N_4^{+*}$ (excited vibrationally) and the N_3^+ is formed by the process $N_2^{+*} + N_2 \rightarrow N_3^+ + N$ where N_2^{+*} is an excited ion. N_4^+ and N_3^+ currents decrease with increasing E/p in the source, suggesting that they may be dissociated by molecular impacts. The N_4^+ ions are considerably more readily lost than the N_3^+ ions. Since the formation of N_3^+ must necessarily release a nitrogen atom, this process constitutes a form of dissociation of N_2 which may account for the value of the dissociation energy of 7.38 eV found by some methods.

537.563 : 539.19

3607. PHOTODETACHMENT OF O_2^-.
D.S.Burch, S.J.Smith and L.M.Branscomb.
Phys. Rev., Vol. 112, No. 1, 171-5 (Oct. 1, 1958).

The cross-section for photodetachment of O_2^- has been measured for the range of photon energies 0.5 to 3.0 eV. No onset energy is discovered in this range but analysis of the data gives an extrapolated threshold at 0.15 ± 0.05 eV. The curve is found to rise gradually with increasing slope, reaching a value of 2.4×10^{-18} cm^2 at 3.0 eV photon energy. Comparison of the data with the predictions of threshold law theory and the results of previous experiments results in an interpretation in terms of assumed potential curves for O_2^-.

537.563 : 539.19

3608. THEORY OF THRESHOLD ENERGY DEPENDENCE OF PHOTODETACHMENT OF DIATOMIC MOLECULAR NEGATIVE IONS. S.Geltman.
Phys. Rev., Vol. 112, No. 1, 176-8 (Oct. 1, 1958).

The energy dependence near zero energy of the continuum wave function of an electron in a molecular potential field is found by an iterative solution of the wave equation. This leads to shapes for the photodetachment cross-section near threshold which are found to depend on whether the molecular ion is heteronuclear or homonuclear and on the u, g symmetry (for homonuclear case) of the outer molecular orbital. The predicted energy dependences are found to be consistent with the available experimental data.

537.563

3609. SECONDARY IONIZATION PROCESSES IN HYDROGEN AT HIGH GAS PRESSURES.
D.K.Davies, J.Dutton and F.Llewellyn Jones.
Proc. Phys. Soc., Vol. 72, Pt 6, 1061-73 (Dec., 1958).

This paper describes accurate experimental measurements of the spatial growth of ionization in steady state conditions in hydrogen at high pressures (100 to 450 mm Hg) using an apparatus and procedure previously described (Crompton, Dutton and Haydon 1956). The values of the secondary ionization coefficient ω/α obtained from these measurements by means of the method of analysis developed in that paper show that, at a constant value of E/p (E the field, p the gas pressure), the value of ω/α is dependent both on the nature of the cathode and on the pressure of the gas. The variation in the value of ω/α with the material of the cathode shows that the predominant secondary ionization process in hydrogen at high pressures are cathode dependent processes, thus confirming the previous work. A theoretical investigation of the possible cathode-dependent processes in hydrogen shows that the variation in the value of ω/α with gas pressure may be satisfactorily explained on the assumption that the photoelectric process is predominant and that excited molecules undergo collisions of the second kind with neutral gas molecules, so that the molecular collision frequency affects the rate of production of photons. Theoretical computations of the value of ω/α based on the assumption that the photoelectric process at the cathode is the predominant secondary ionization process, and using previously measured values of the atomic constants involved, give good agreement with experiment. Measurements of sparking potentials to within 1% show, in agreement with theory, that such measurements are not sufficiently precise to detect the departures from Paschen's law consequent on the observed dependence of the value of ω/α on gas pressure.

537.564

3610. ON THE PROBLEM OF THE TECHNIQUE OF MEASUREMENT OF THE EFFECTIVE CROSS-SECTIONS OF PROCESSES OF FORMATION OF NEGATIVE IONS BY ATOMIC COLLISIONS.
Ya.M.Fogel', R.V.Mitin and V.F.Kozlov.
Zh. tekh. Fiz., Vol. 28, No. 7, 1526-37 (1958). In Russian.

The method used was to pass a fine beam of positive ions, after passage through a magnetic monochromator and a collimator, into a chamber containing gas at low pressure in a uniform magnetic field. All of the negative ions from a known length of the positive-ion-beam path, defined by the dimensions of the apparatus, were deflected by the magnetic field to an insulated electrode. The ratio of this negative current to the primary positive current then gave the proportion of positive ions undergoing double-charge-transfer. With the help of this method was measured the cross-section for this process for ions of H^+ from about 4 to 50 keV in hydrogen and krypton, and for ions of C^+, O^+ and Cl^+ (from 10 to 50 keV) in krypton. Agreement was obtained with mass-spectrometer methods, the cross-section obtained having values between 10^{-19} and 10^{-16} sq. cm. The results showed that the double charge-transfer caused only a very small angular deflection of the negative ions formed from the path of the primary beam. J.H.Fremlin

537.565

3611. THE MOBILITY OF NEGATIVE IONS IN AIR.
I.I.Balog and Kh.A.Dzherpetov.
Zh. tekh. Fiz., Vol. 28, No. 6, 1263-6 (1958). In Russian.

Investigations are described of mobility in dry air and in air containing different concentrations of water vapour at E/p (E = field strength; p = pressure) of up to 35 V/cm. mm Hg. For dry air, the mobility at low E/p remains constant up to a certain critical value of E/p when it increases to a maximum after which it shows a gradual decrease. For moist air, the mobility at low E/p decreases with E/p; this is due to formation of complex ions. Z.Krasucki

537.568 : 539.18

ELASTIC SCATTERING OF SLOW IONS IN THEIR PARENT GASES. See Abstr. 2865

COSMIC RAYS

537.591.1

3612. A SEARCH FOR PARTICLES OF 550 M_e.
M.Conversi, E.Fiorini, S.Ratti, C.Rubbia, C.Succi and G.Torelli.
Nuovo Cimento, Vol. 9, No. 4, 740-4 (Aug. 16, 1958).

An arrangement of two cloud chambers and a proportional liquid scintillation counter was used at an altitude of 2550 m to measure the ionization and residual range of cosmic-ray particles entering the apparatus. No evidence has yet been obtained for particles of mass in the region of 550 M_e, though the authors estimate that six might have been expected on the basis of results reported by Alikhanyan et al. S.J.Goldsack

537.591.1

3613. POSSIBLE EXPLANATION OF THE RADIATION OBSERVED BY VAN ALLEN AT HIGH ALTITUDES IN SATELLITES.
P.J.Kellogg.
Nuovo Cimento, Vol. 11, No. 1, 48-66 (Jan. 1, 1959).

The author considers the possibility, suggested by P.Rothwell and T.Gold, that the radiation observed by Van Allen and co-workers at high altitudes is due to the decay electrons and protons from neutrons produced in the earth's atmosphere by cosmic rays and stored in the earth's magnetic field. Order of magnitude estimates for the densities to be expected are presented. Only scattering loss is considered. Using a lifetime of 3×10^9 sec for loss through scattering, an upper limit of 10^{-2} electrons/cm^3 near the earth and $0.05(R_E/r_0)^3$ electrons/cm^3 at large distances r_0 in the equatorial plane is obtained. The proton density at large distances is $0.03(R_E/r_0)^2$ cm^{-3}, for a lifetime of 10^{12} sec. If plasma accelerations are not important, then the spectrum of electrons will be that of neutron β-decay. The protons are produced by fast neutrons coming directly from nuclear stars and their spectrum will be approximately that of the protons from stars. The electron density is sufficient to give a counting rate a few times larger than is observed, while the proton density is sufficient to give a counting rate 10^4 times higher than the observed lower limit. The lifetimes of stored particles are therefore probably much less than those given by scattering. There should be a strong latitude effect which is roughly estimated as proportional to $\cos^6\lambda$. Reasons are given for believing that collective effects will reduce the density below this near the poles.

537.591.1

3614. HIGH Z NUCLEI IN COSMIC RADIATION.
V.Bisi, R.Cester, C.M.Garelli and L.Tallone.
Nuovo Cimento, Vol. 10, No. 5, 881-91 (Dec. 1, 1958).

Adding the results obtained by measuring the charges of 117 heavy nuclei ($Z \geq 10$) to those obtained in a previous paper, values of the ratio $N(Z \geq 15)/N(Z \geq 10)$ were determined at flight altitude and at the top of the atmosphere, and of the ratio $N(Z = 26)/N(Z \geq 10)$ at flight altitude, at the top of the atmosphere and at the cosmic-ray source. It results that the chemical composition of the cosmic-ray source differs from the average composition of the universe, being much richer in heavy nuclei ($Z \geq 15$) and in particular in iron. The absorption mean free path in air was also determined studying the zenith angle dependence of cosmic-ray flux.

537.591.15

3615. DEPENDENCE OF THE NUCLEONIC COMPONENT OF COSMIC RAY AIR SHOWERS ON RADIUS.
C.S.Wallace, M.M.Winn and K.W.Ogilvie.
Nature (London), Vol. 182, 1653-4 (Dec. 13, 1958).

The Sydney air shower apparatus in conjunction with an I.G.Y. neutron monitor as nucleon detector was used to investigate the above. It is assumed that the number of air shower nucleons interacting is Poissonian with mean n(N,r), that the interaction releases a number of neutrons M(N,r) and that the detection efficiency p for neutrons is independent of N and r and is small. A variational procedure then gives expressions for m(= Mp) and n valid over the range $10^5 < N < 2 \times 10^6$:

$$m \propto N^{0.15 \pm 0.05}\, r^{-0.25 \pm 0.05} \quad (4\text{m} < r < 60\text{m})$$

$$n \propto N^{0.47 \pm 0.1}\, r^{-0.92 \pm 0.1} \quad (5\text{m} < r < 50\text{m})$$

(N = total number of shower particles, r = radius from shower core).
R.H.W.Johnston

537.591.15 : 539.12

3616. ELECTRON NUMBER DISTRIBUTION IN ELECTRON–PHOTON SHOWERS. J.C.Butcher and H.Messel.
Phys. Rev., Vol. 112, No. 6, 2096-106 (Dec. 15, 1958).

Numerical results for the number distribution of electrons above a given energy due to primary electrons and photons are given. The average numbers derived from the distributions are also given. Values are presented both for the case of approximation A and for more accurate cross-sections at low energies in air. Collision losses and Compton effect are taken into account but scattering at low energies is neglected. The calculations were carried out using Monte Carlo methods on the electronic digital computer SILLIAC. The results of the calculations are discussed and compared with previous work on the subject.

537.591.15

3617. ON THE SIZE DISTRIBUTION OF EXTENSIVE ATMOSPHERIC SHOWERS. G.V.Kulikov and G.B.Khristiansen.
Zh. eksper. teor. Fiz., Vol. 35, No. 3(9), 635-40 (1958). In Russian.

Experimental data on the distribution of atmospheric showers with respect to the number of particles in a shower are given for particle numbers ranging from 10^5 to 2×10^6. An analysis of these data and the data available in the literature indicates that when the number of particles lies between 10^6 and 10^7 there is very probably an irregularity in the shower-size distribution curve. This favours the hypothesis of the metagalactic origin of cosmic rays with energies $> 10^{16}$ eV.

537.591.3 : 523.51

PRODUCTION OF HELIUM IN IRON METEORITES BY THE ACTION OF COSMIC RAYS. See Abstr. 3053

537.591.5

3618. COSMIC-RAY INTENSITY VARIATIONS DURING TWO SOLAR CYCLES. S.E.Forbush.
J. geophys. Res., Vol. 63, No. 4, 651-69 (Dec., 1958).

An improved correction for instrumental drift at Huancayo is derived and the reliability of the corrections for seasonal variations is discussed. From ionization chambers, the decrease of intensity from its maxima (near sunspot minima) is shown to lag a year or more behind the increase of solar activity following sunspot minima. This lag does not appear in the results obtained by Neher at high altitude and high latitude, nor in those obtained by Rose from a neutron monitor at Ottawa. The variability of daily means of cosmic-ray intensity (from monthly means) is in 1957 the largest observed during two complete solar cycles. Tables of monthly means corrected for seasonal wave are included, together with graphs of daily means at Huancayo for the period 1954-57.

537.591.5

3619. RAPID DECREASE OF COSMIC RAY INTENSITY. J.F.Steljes and H.Carmichael.
Nuovo Cimento, Vol. 10, No. 2, 393-4 (Oct. 16, 1958).

A decrease of up to 6% in the neutron component on 11 Feb. 1958 is related to a smaller decrease in the meson flux. It appeared to begin about 5 min before a magnetic storm, and was complete about 30 min sooner than the main meson decrease. E.J.Burge

537.591.5

3620. FLUX OF COSMIC-RAY PARTICLES WITH $Z \geq 2$ OVER TEXAS. A.Engler, M.F.Kaplon and J.Klarmann.
Phys. Rev., Vol. 112, No. 2, 597-605 (Oct. 15, 1958).

The fluxes of multiply charged cosmic-ray particles were measured with nuclear emulsions in a high-altitude balloon flight. The identification of α-particles was based on "blob-gap" measurements; that of elements with $Z \geq 3$, on δ-ray densities. The charge resolution obtained was satisfactory. To calculate the fluxes at the top of the atmosphere an extrapolation procedure, previously introduced in this laboratory, was employed. Two sets of parameters which account for the interactions in the residual atmosphere, differing considerably as far as their influence on the fluxes of light elements is concerned, were used. The results, in particles per m^2 sec sterad, are as follows:

	Set I	Set II
$Z = 2$	90.9 ± 8.0	89.2 ± 8.0
$3 \leq Z \leq 5$	1.68 ± 0.32	0.45 ± 0.36
$6 \leq Z \leq 9$	5.60 ± 0.58	6.05 ± 0.56
$Z \geq 10$	2.19 ± 0.38	2.19 ± 0.38

537.591.5

3621. VARIATIONS IN THE COSMIC-RAY NUCLEONIC INTENSITY. J.A.Lockwood.
Phys. Rev., Vol. 112, No. 5, 1750-8 (Dec. 1, 1958).

The monthly mean intensity of the nucleonic component of cosmic radiation measured at Mt.Washington, geographic latitude 44.2° N and elevation 6262 ft, decreased 22% from July, 1954 to December, 1957. The decreased intensity now prevailing came about through a series of sudden decreases from which only partial recovery occurred. During this same period, the amplitude of the day-to-day intensity changes has increased. A study has been made of the largest Forbush-type decreases which have occurred in this interval. Many of these intensity drops have a decrease rate $\sim 1.5\%\ \text{hr}^{-1}$, with a maximum rate of $2.5\%\ \text{hr}^{-1}$. In some cases they are preceded by a slight increase of $\sim 1.5\%$. These decreases do not have a similar time dependence. There is no apparent 27 day recurrent tendency for these sudden drops. The energy dependency of these events is variable. The restrictions which these decreases impose upon the existing models of solar modulation mechanisms are discussed.

537.591.8

3622. INVESTIGATION OF NUCLEAR INTERACTIONS OF ENERGIES BETWEEN 10 AND 100 GeV.
E.Fenyves, E.Gombosi and P.Surányi.
Nuovo Cimento, Vol. 11, No. 1, 21-5 (Jan. 1, 1959).

The angular and energy distribution of shower particles of seven nuclear interactions, mostly complex collisions, were measured. The Lorentz factor γ_{cm} of the centre of mass system (c.m.s.) was determined from the energy of secondaries and the Lorentz factor γ_{sym} of the symmetry system was obtained from the angular distribution. It was found that $\gamma_{sym}/\gamma_{cm} = 0.92 \pm 0.15$, which corresponds to a symmetrical emission of shower particles in the c.m.s. Energy distribution in the c.m.s. as well as transversal momentum distribution of shower particles were also determined.

537.591.8

3623. ON THE INTERPRETATION OF COSMIC RAY JETS: THE "FUNNEL" MODEL. T.Gozani and K.Sitte.
Nuovo Cimento, Vol. 11, No. 1, 26-43 (Jan. 1, 1959).

Arguments are presented in favour of the interpretation of cosmic ray jets as composite collisions, in a single act, of the primary with a compound of target nucleons. In particular, it is pointed out that the identity of "successive" collisions is lost at high energies, because the expanding meson cloud enwraps the compound before ejecting the bulk of the secondaries. According to this view, the primary energies assigned to the jets by the customary procedures are too low in many cases, and especially for events with large numbers N_h of heavy prongs. The resulting difference in the true primary energies of the jets with, say $N_h \leq 3$ and $N_h > 3$ accounts for the apparently excessive frequency of the events of low N_h. But if one wishes to retain the model of the nucleus as an aggregate of corpuscles, the cross-section of the avalance of interacting nucleons will increase with penetration, and the usual picture of the interaction volume shaped like a cylindrical tunnel must be replaced by that of an inverted funnel. This "funnel model" predicts a stronger dependence of the multiplicities on the atomic weight of the target nucleus, and seems to fit the — rather scanty — experimental data somewhat better. It is then shown that according to this model, the larger part of the observed multiplicity spread is not due to the "fundamental fluctuations" in the emission of secondaries in a nucleon—nucleon collision, but to the randomness in the number of particles involved. For nucleon—nucleon interactions at about 5×10^{12} eV, the "fundamental fluctuations" can be approximated by a Gaussian with a width $\sigma = 6.5$.

537.591.8 : 539.12

3624. ENERGY SPECTRUM OF π MESONS PRODUCED BY INTERACTION OF COSMIC RADIATION WITH EMULSION NUCLEI.
H.Yagoda.
Phys. Rev., Vol. 112, No. 6, 2087-95 (Dec. 15, 1958).

An analysis of 958 π mesons ejected from stars which terminate their range in G5 emulsion exposed in the stratosphere showed a predominance of negative mesons. The average ratio from all emulsion interactions over a pion kinetic energy $\gtrsim 45$ MeV was $\pi^-/\pi^+ = 5.17 \pm 0.41$. Further study showed that this ratio varied with the charge of the target nuclei and was strongly dependent on the kinetic energy of the emitted mesons. By classifying the stars on the basis of the sum of the charges on the evaporation tracks a large fraction of the stars can be attributed to the disintegration of heavy (Ag—Br—I) or light (C—N—O) target nuclei. On this basis

537 pions originate from heavy nuclei and 297 from light nuclei. The residual group of 124 mesons arise from peripheral collisions with heavy or light target nuclei, interactions with hydrogen, photomeson production and fundamental particle decay processes. The variation of the charge ratio with pion kinetic energy was evaluated for both the light and heavy emulsion nuclei and compared with the yield from targets of similar charge employed in cyclotron studies. The energy spectrum of the mesons produced by cosmic ray interactions on emulsion nuclei from 1.5 to 33 MeV showed good agreement with early Bristol measurements of shower particles originating from stars and with more recent studies of ejected mesons by the Russian group. The form of the differential energy spectrum appears to be largely independent of geomagnetic latitude and altitude of the exposure when the meson yield is expressed in units of particles per shower star per MeV.

537.591.8 : 539.12

KNOCK-ON ELECTRONS FROM COSMIC-RAY μ-MESONS.
See Abstr. 2606

537.591.8 : 539.17

INTERACTION OF COSMIC-RAY PARTICLES WITH VARIOUS NUCLEI.
See Abstr. 2837

MAGNETISM

538.113 : 537.311.33

3625. THEORY OF IMPURITY PARAMAGNETISM IN SEMICONDUCTORS AT LOW TEMPERATURES.
J.Seiden.
C.R. Acad. Sci. (Paris), Vol. 247, No. 25, 2313-15 (Dec. 22, 1958). In French.

The paramagnetism due to electrons on un-ionized donors is discussed for concentrations which are sufficiently high so that the interactions among the impurities becomes important. A simple discussion in terms of the Ising model is given. P.T.Landsberg

538.114

3626. THE THEORY OF THE NÉEL CHAIN.
E.Ledinegg and P.Urban.
Acta phys. Austriaca, Vol. 12, No. 2, 144-54 (1958). In German.

An extension of a previous modified spin—wave treatment (Abstr. 4691/1954) of the linear chain to any number f of nearest neighbours. It is shown that the disordering influence of an external magnetic field, anti-parallel to the ground state spin direction, goes to zero as $f^{-\frac{3}{2}}$ when the exchange integral has the same value for all nearest neighbours. This condition can be approximated by a suitable coiling up of the linear chain. A.J.Manuel

538.114

3627. EFFECTIVE PARAMETERS IN FERRIMAGNETIC RESONANCE.
R.K.Wangsness.
Phys. Rev., Vol. 111, No. 3, 813-16 (Aug. 1, 1958).

The steady state solution for the susceptibility tensor of a two-sublattice system has been found by using sublattice equations of motion which include complete Landau—Lifschits relaxation terms with individual relaxation parameters and which describe relaxation toward the instantaneous total field acting on the sublattice. It is shown that one can define effective parameters describing the behaviour of the system as a whole which remain finite throughout the compensation region and, in particular, insure that the absorption coefficient will remain positive. It is also found that the effective gyromagnetic ratios characterizing the absorption and Faraday effect are different in principle, and a new term is found in the expression for the off-diagonal element which is a consequence both of the sublattice structure and total field relaxation. In the case of small damping, many of these distinctions disappear and some parameters reduce to those previously obtained. It is shown that the inclusion of total field relaxation is necessary to obtain results which are unambiguous and correct in principle; the magnetization line width product is also shown to be continuous, but vanishing at the compensation point for angular momentum.

538.114 : 539.2 : 548.74

3628. FIELD DEPENDENCE OF NEUTRON SCATTERING BY SPIN WAVES.
B.N.Brockhouse.
Phys. Rev., Vol. 111, No. 5, 1273-4 (Sept. 1, 1958).

The energy distribution of neutrons scattered in the vicinity of the 111 reciprocal lattice point of magnetite have been measured with and without a magnetic field along the scattering vector. The intensity with a magnetic field was greater than with no field by a factor of 1.41 in approximate agreement with the theoretical value of 1.5, showing that the one-quantum spin wave scattering depends on the orientation of the spin system in the way predicted by theory. For spin waves of very low energy, competing effects of opposite sign apparently exist which render small the over-all effect of a magnetic field on the diffuse scattering.

538.114

3629. COMMENTS ON A THEORY OF DOUBLE BLOCH WALLS IN THIN FILMS.
R.E.Behringer.
J. appl. Phys., Vol. 29, No. 9, 1380-1 (Sept., 1958).

Notes an inconsistency in Kaczér's theory (Abstr. 8874/1958). If the film is sufficiently thin for the anisotropy constant to be replaced by $2\pi I_S^2$, where I_S is the saturation magnetization of the specimen, the Néel type wall (Abstr. 6766/1956) results in a lower energy than the type of wall proposed by Kaczér. The dipole—dipole interaction energy then has the reverse sign and the resulting relation between field, film thickness and distance between walls is given. It is deduced that unwinding walls cannot exist in very thin ideal films and that nonunwinding walls can exist only when a field is applied contrary to the direction of magnetization of the central domain. D.M.Edwards

538.114

3630. THEORY OF BLOCH ELECTRONS IN A MAGNETIC FIELD.
W.Kohn.
Proc. Phys. Soc., Vol. 72, Pt 6, 1147-50 (1958).

The energy levels corresponding to closed and open trajectories of a Bloch wave-packet are discussed, and improved expressions are given for the area enclosed by a closed trajectory. P.T.Landsberg

538.114 : 539.12

WEISS MAGNETIC FIELD EVALUATION. ELECTRON POLARIZATION.
See Abstr. 2578

538.22

3631. ON THE PROPERTIES OF THE RARE-EARTH METALS.
P.G. de Gennes.
C.R. Acad. Sci. (Paris), Vol. 247, No. 21, 1836-8 (Nov. 24, 1958). In French.

Assuming the ions are coupled only by the spins of the conduction electrons, the paramagnetic Curie point is shown to vary as $(g-1)^2J(J+1)$. This result is confirmed by experiment for the series Gd to Tm. The frequent occurrence of metamagnetism and the anomalies in resistivity and specific heat are also briefly explained. R.C.Kell

538.22

3632. SOME COMMENTS ON THE ANOMALOUS MAGNETIC BEHAVIOR OF CERTAIN Ni(II) COMPLEXES.
C.J.Ballhausen and A.D.Liehr.
J. Amer. Chem. Soc., Vol. 81, No. 3, 538-42 (Feb. 5, 1959).

The magnetic and spectral properties of tetra-coordinated Ni(II) complexes are discussed in the light of the modern theory of ligand fields. It is pointed out that for such Ni(II) complexes there exist both strong experimental evidence and convincing theoretical arguments against (a) the existence of dsp^2 bonding, and (b) the existence in solutions and melts of planar-tetrahedral conformational equilibria. Equations governing the magnetic susceptibility of partially paramagnetic planar Ni(II) systems are derived and their usefulness in determining the singlet-triplet energy separation is underlined. Some conjectures concerning the nature of the famous Lifschitz salts of nickel are presented and an interesting analogy between these compounds and the recently characterized copper alkanoates is noted.

538.22

3633. MAGNETIC PROPERTIES OF SPIN-FREE TRANSITION SERIES COMPLEXES.
B.N.Figgis.
Nature (London), Vol. 182, 1568-70 (Dec. 6, 1958).

A review of the literature on the ground states of d electrons in spin-free transition series complexes together with calculations of the d^n configurations where these are not otherwise available. Ligand fields are classified as strong, medium or weak and the magnetic properties of all the d^n configurations are outlined for medium and weak fields. The information is presented graphically and is discussed in relation to the interpretation of the variation of magnetic moment with temperature. A.E.De Barr

538.22

3634. MAGNETIC PROPERTIES OF TERBIUM METAL.

W.C.Thoburn, S.Legvold and F.H.Spedding.
Phys. Rev., Vol. 112, No. 1, 56-8 (Oct. 1, 1958).

Results of magnetic measurements on metallic terbium over the temperature range from 4° to 375°K and in fields ranging from 50 to 18 000 Oe are reported. The metal is found to have a paramagnetic Curie point of 237°K. Tests with fields of from 50 to 800 Oe indicate an order-to-disorder transition at approximately 230°K which is evidently a Néel point. It appears that terbium has a weakly bound antiferromagnetic ordering for temperatures between 218° and 230°K, this ordering being gradually changed to ferromagnetic in fields exceeding 200 Oe. Below 218°K the metal is ferromagnetic. The magneton numbers obtained from the paramagnetic susceptibility measurements and from the extrapolated ferromagnetic saturation moment are in good agreement with values calculated for the free ion.

538.22

3635. MAGNETIC SUSCEPTIBILITY OF AN ELECTRON GAS AT HIGH DENSITY.

K.A.Brueckner and K.Sawada.
Phys. Rev., Vol. 112, No. 2, 328-9 (Oct. 15, 1958).

Determined using the exact theory of Gell-Mann and Brueckner (Abstr. 6372/1957).

538.22

3636. DETERMINATION OF THE MAGNETIC ANISOTROPY OF SINGLE CRYSTALS FROM MAGNETIC TORQUES MEASURED WITH QUARTZ FIBERS.

D.A.Gordon.
Rev. sci. Instrum., Vol. 29, No. 11, 929-34 (Nov., 1958).

The method of investigating the magnetic anisotropy of single crystals by observing the torque exerted on a crystal by a homogeneous magnetic field was found to be subject to several sources of error which were of particular importance when small differences of susceptibility were involved. Several changes in design of the equipment and in the experimental procedure were introduced, resulting in a great improvement in the reproducibility of the measurements; these changes included the introduction of effective draft shielding, the use of high magnetic fields to saturate ferromagnetic impurities, and the use of graphical method of data analysis. The method of determining the torsion constants of thin quartz fibres from the period of oscillation of a torsion pendulum was also investigated; for accurate values it is necessary that the oscillating pendulum be under high vacuum and shielded from static electricity. A slight decrease in the torsion constants of quartz fibres left under tension for long periods of time was observed. A systematic method of mounting and orienting the crystal specimens was also devised.

538.221 : 621.317.62 : 621.318.013

3637. AN (ELECTRIC-CIRCUIT) ANALOGUE OF THE SKIN EFFECT IN A FERROMAGNETIC METAL.

V.G.Vitol and I.M.Kirko.
Zh. tekh. Fiz., Vol. 28, No. 9, 2055-61 (1958). In Russian.

An iterated network system (containing saturable core inductors and series and shunt resistors), to the end of which alternating voltages (50 c/s) could be applied, is proposed as a useful analogue for studying the penetration of alternating electro-magnetic fields into ferromagnetics. (With permeability a nonlinear function of field the problem is mathematically intractable). The shape of the permeability curve for the inductor cores and the resistance values required for the analogy to hold in a given case are derived. As examples of the method, the variation of permeability with depth and external field are obtained for two plates of a particular ferromagnetic — one thick and the other thin in comparison with the skin depth.

K.F.Hulme

538.221

3638. THE INTERPRETATION OF THE MAGNETIC PROPERTIES OF ERBIUM GARNET IN WHICH Al^{3+} AND Cr^{3+} IONS HAVE BEEN SUBSTITUTED FOR Fe^{3+}.

G.Villers, J.Loriers and R.Pauthenet.
C.R. Acad. Sci. (Paris), Vol. 247, No. 5, 587-90 (Aug. 4, 1958). In French.

A series of compounds were prepared with the formula $(5-x)Fe_2O_3$, $x\ Me_2O_3$, $3Er_2O_3$ in which Me designates Al or Cr and x varies between 0 and 1. Measurements were made of the spontaneous magnetization temperature of compensation and the Curie temperatures. The results can be interpreted by supposing that the Al^{3+} ions occupy tetrahedral sites and the Cr^{3+} ions octahedral sites.

D.J.Oliver

538.221

3639. INITIAL AND REMANENT PERMEABILITY SPECTRA OF YTTRIUM IRON GARNET.

R.D.Harrington and A.L.Rasmussen.
Proc. Inst. Radio Engrs, Vol. 47, No. 1, 98 (Jan., 1959).

The complex permeability of polycrystalline garnet was measured as a function of frequency. A relaxation, probably due to domain wall displacements, occurs at about 10 Mc/s, and a resonanc probably associated with domain rotation, occurs at about 150 Mc/s. The present attempts to improve the low frequency performance by decreasing the saturation magnetization are, therefore, likely to affect only part of the low field loss.

R.C.Kell

538.221 : 548.736.5

3640. CRYSTAL STRUCTURE AND FERRIMAGNETISM IN $NiMnO_3$ AND $CoMnO_3$.

W.H.Cloud.
Phys. Rev., Vol. 111, No. 4, 1046-9 (Aug. 15, 1958).

X-ray diffraction studies of individual crystals of $NiMnO_3$ and $CoMnO_3$ show that these compounds have the structure of ilmenite (space group $R\bar{3}$). The crystals have a plate-like crystal habit with the threefold symmetry axis perpendicular to the faces of the platelet. Positions of atoms within the unit cell have been determined by comparing calculated structure factors with those obtained from X-ray powder patterns. There are two Ni—O—Mn configurations that appear to be favourable to a magnetic superchange interaction, and these are sufficient to extend magnetic ordering in three dimensions.

538.221

3641. CATION SUBSTITUTIONS IN $BaFe_{12}O_{19}$.

A.H.Mones and E.Banks.
J. Phys. Chem. Solids, Vol. 4, No. 3, 217-22 (1958).

The variation in magnetic intensity of $BaFe_{12}O_{19}$ was studied as a function of the substitution of ions such as Al^{III}, Ga^{III}, Cr^{III}, and Zn^{II} for Fe^{III}. All the substituted ions, with the exception of Cr^{III}, were nonmagnetic. The fields employed were not sufficient for magnetic saturation of the polycrystalline preparations; single crystals of some preparations, principally in the Ga^{III} series, were magnetically saturated. From the magnetic saturation and nonsaturation data, some tentative conclusions are drawn regarding the preference of the substituted ions in the available sites, which are octahedrally and tetrahedrally surrounded by oxygen in the structure.

538.221 : 537.312.62

FERROMAGNETIC SUPERCONDUCTORS. See Abstr. 3512

538.222

3642. MAGNETIC SUSCEPTIBILITY OF COPPER—NICKEL AND SILVER—PALLADIUM ALLOYS AT LOW TEMPERATURES.

E.W.Pugh and F.M.Ryan.
Phys. Rev., Vol. 111, No. 4, 1038-42 (Aug. 15, 1958).

The magnetic susceptibilities of copper—nickel alloys with up to 39 atomic per cent nickel and silver—palladium alloys with up to 10 atomic per cent palladium were measured by the Gouy method at temperatures between 295° and 2.1°K. Measurements are reported on samples with an impurity content of less than 10 parts per million and on samples with greater impurity content. The susceptibility is nearly temperature-independent for all the silver—palladium alloys and for the copper—nickel alloys with up to 27% nickel. Higher nickel concentrations give rise to a 1/T susceptibility term which is too large to be accounted for by impurity content. The simple band model of Mott adequately describes the susceptibility of the silver—palladium alloys but fails to predict the large temperature-independent paramagnetic contribution of nickel in copper. Exchange energies calculated by the Stoner collective electron method for the copper—nickel alloys, using specific heat and susceptibility data, are somewhat unsatisfactory and suggest the presence of another mechanism.

538.222

3643. MAGNETIC ABSORPTION IN THE SPIN SYSTEM OF SOME PARAMAGNETIC SALTS AT ABOUT 1325 MHz.

H.Hadders, P.R.Locher and C.J.Gorter.
Physica, Vol. 24, No. 10, 839-47 (Oct., 1958).

An apparatus has been constructed for the measurement of paramagnetic losses and paramagnetic susceptibilities at a frequency of 1325 Mc/s. The properties of this set up are discussed; particularly a method is given by which the measured χ'' can be related to the static susceptibility χ_0. Results are presented on the losses of powdered $CrK(SO_4)_2.12H_2O$, $FeNH_4(SO_4)_2.12H_2O$, $Mn(NH_4)_2(SO_4)_2.6H_2O$ and $Cu(NH_4)_2(SO_4)_2.6H_2O$ at liquid hydrogen temperatures as a function of a parallel and of a perpendicular static magnetic field. In a provisional theoretical discussion it is suggested that in parallel fields the absorption connected with the non-diagonal elements of the magnetic moment plays a dominating role.

538.222 : 539.12

INELASTIC MAGNETIC SCATTERING OF NEUTRONS AT HIGH TEMPERATURES. See Abstr. 2599

538.24 : 535.218

3644. INFLUENCE OF LIGHT UPON THE MAGNETIZATION OF MASSIVE IRON. H.E.Stauss.
Amer. J. Phys., Vol. 26, No. 8, 551-2 (Nov., 1958).

Recently Lamarsh called attention (see Abstr. 3451/1957) to old experiments that indicated an influence of light upon the magnetization of massive iron. One of the experiments was repeated under conditions as free as possible from disturbing conditions that may have influenced the original experiments. No influence of light upon the magnetization of iron was observed. The upper limit of possible change of magnetization in the specimen that may have escaped detection was one cgs unit of intensity of magnetization I.

538.245

3645. THIN FILM MAGNETIZATION REVERSAL BY COHERENT ROTATION. P.R.Gillette and K.Oshima.
J. appl. Phys., Vol. 29, No. 10, 1465-71 (Oct., 1958).

Several theoretical analyses of the process of magnetization reversal in thin films by coherent rotation of the magnetization vector were published. However, these analyses suffer from the use of questionable assumptions and from a lack of generality. This paper presents results obtained by employing an electronic digital computer to solve differential equations of greater accuracy and generality than those previously used. These results show how the optimum damping factor (which, as defined herein, differs slightly from the critical damping factor), the peak output voltage, and the reversal time vary with the magnitude and direction of a field applied to a thin ferromagnetic film with uniaxial anisotropy. The results for a particular direction of applied field show that the optimum damping factor and the peak voltage increase and the reversal time decreases with increasing magnitude of the field; and that a plot of reciprocal reversal time v. field magnitude is a parabola if the damping factor is always equal to its optimum value, but a hyperbola if the damping factor is a constant.

538.245 : 621.318.13

3646. MAGNETIZATION REVERSAL BY ROTATION AND WALL MOTION IN THIN FILMS OF NICKEL—IRON ALLOYS.
E.M.Bradley and M.Prutton.
J. Electronics and Control, Vol. 6, No. 1, 81-96 (Jan., 1959).

The magnetization reversal process in specially prepared uniaxial thin films of nickel—iron alloy is studied by measurements of the 400 c/s hysteresis loops. The results indicate that both coherent rotation and domain wall motion can occur in the same film, but in different proportions according to the orientation of the anisotropy axis with respect to the applied field and the thickness of the film. Special properties of these films are discussed for fields applied normal to the anisotropy axis.

538.245 : 518.5 : 621.317.79

3647. AN ELECTRICAL ANALOGUE OF MAGNETIC DOMAINS.
P.F.Davis.
Rep. Brit. Elect. Res. Assoc., Rep. N/T78, 4 pp.(1957).

An analogue for elucidating the domain structure in a picture frame specimen of a single crystal of iron is described. It may be used for finding either the magnetic energy or the field associated with a domain structure. Two forms of the analogue are described. One consists of a square mesh network of resistance wires composed of different gauges of wire running in different directions, the wires having the highest resistance per unit length run in the direction analogous to the direction of magnetization of the domain. The other form consists of parallel plates of resistive material immersed in an electrolytic tank.

538.245

3648. THERMAL ACTIVATION OF FERROMAGNETIC DOMAINS.
F.D.Stacey.
Proc. Phys. Soc., Vol. 73, Pt 1, 136-8 (Jan., 1959).

Derives an expression for the probability of a particular energy being available to overcome the potential barrier inhibiting the movement of a domain wall. A.E.De Barr

538.245

3649. THE ANTIFERROMAGNETICISM OF $CuCl_2.2H_2O$.
W.Marshall.
J. Phys. Chem. Solids, Vol. 7, No. 2-3, 159-64 (Nov., 1958).

A simple explanation is given of the unusual behaviour of $CuCl_2 \cdot 2H_2O$, which has a Néel temperature of 4.33°K but a broad maximum in the magnetic susceptibility at about 4.8°K. The explanation is based upon the fact that in $CuCl_2 \cdot 2H_2O$ the strongest interaction exists only in linear chains, and hence it is not as effective in determining the long-range order as it is in determining the short-range order.

538.245 : 538.614

3650. OBSERVATION OF DOMAINS IN THE FERRIMAGNETIC GARNETS BY TRANSMITTED LIGHT. J.F.Dillon,Jr.
J. appl. Phys., Vol. 29, No. 9, 1286-91 (Sept., 1958).

It was found that single crystals of the ferrimagnetic YFe, GdFe and other garnets are transparent to visible light. Thin sections (e.g. 0.005 cm thick) transmit sufficient light for microscopic examination. The transmitted light undergoes a nonreciprocal rotation similar to the Faraday effect. By virtue of this rotation many features of the domain structure are readily visible. A magnetic birefringence was also observed which can be used to differentiate domains whose magnetization lies perpendicular to the line of sight. It is possible to study domain structure at any temperature below the Curie point. The effects of strains set up by the polishing procedure are discussed. Finally, mention is made of possible combined microwave-optical experiments, as well as experiments aimed at understanding the switching process.

538.245 : 537.312.62

SUPERCONDUCTIVITY AND FERROMAGNETISM IN ISOMORPHOUS COMPOUNDS. See Abstr. 3507

ELECTROMAGNETISM

MAGNETOHYDRODYNAMICS

538.3

3651. A POYNTING THEOREM FOR MOVING BODIES AND THE RELATIVISTIC MECHANICS OF EXTENDED OBJECTS.
N.H.Meyers.
J. Franklin Inst., Vol. 266, No. 6, 439-64 (Dec., 1958).

It is shown that in Chu's modified electrodynamics, which reduces to Maxwell's equations in a rest coordinate system, there is a Poynting-type theorem which can be interpreted physically even in the presence of moving media. W.A.Hepner

538.3 : 537.533.75

3652. MOTION OF A CHARGED PARTICLE IN A RECTANGULAR WAVEGUIDE FILLED WITH ANISOTROPIC DIELECTRIC.
L.S.Bogdankevich.
Zh. tekh. Fiz., Vol. 28, No. 7, 1505-9 (1958). In Russian.

Evaluation of energy losses of the charged particle for two cases: (a) along the optical axis of the crystal filling the waveguide, (b) in the direction of the parallel and perpendicular axes of the waveguide along which the charged particle is moving.
Z.F.Voyner

538.3 : 530.145

METRICAL CONNECTIONS FOR NON-SINGULAR ELECTROMAGNETIC FIELDS IN VACUO. See Abstr. 3112

538.3 : 530.14

THE LAGRANGIAN IN THE CLASSICAL DYNAMICS OF THE ELECTRON. See Abstr. 3116

538.3 : 532.5

3653. ON HELICOIDAL VORTICES IN MAGNETOHYDRODYNAMICS. M.T.Vacca.
Atti Accad. Sci. Torino I, Vol. 92, No. 2, 551-62 (1957-58).
In Italian.

A solution of the equations of motion for an unbounded conducting liquid in the presence of a uniform magnetic field defines a cylindrical vortex in which the vortex lines are coaxial circular helices whose axis is parallel to the applied magnetic field. Expressions are derived for velocities and field intensities inside and outside the vortex. R.A.Newing

538.3 : 532.5

3654. HYDROMAGNETIC WAVES IN IONIZED GAS.
J.H.Piddington.
Monthly Not. Roy. Astron. Soc., Vol. 115, No. 6, 671-83 (1955).

A general theory of weak HM waves in anisotropically conducting gas is developed. There are three such HM waves and for each the velocity, absorption, magnetic and electric fields, the Poynting vector and the gas velocity are found. The physical nature of some

HM wave is discussed; these include, as limiting cases, radiowaves in ionized gas and in vacuo. The effect of Maxwell's displacement current on HM waves is found to be generally small, but it does cause a space-charge electric wave to accompany the HM wave and this could have important consequences.

538.3 : 532.5

3655. EXPERIMENTAL DEMONSTRATION OF HYDROMAGNETIC WAVES IN AN IONIZED GAS.
G.A.Sawyer, P.L.Scott and T.F.Stratton.
Phys. of Fluids, Vol. 2, No. 1, 47-51 (Jan.-Feb., 1959).

A regular hydromagnetic oscillation was excited in a linear discharge tube with metal walls. An externally applied axial magnetic field and discharge currents less than 10^4 amperes were essential to the production of the oscillation. Complete spatial current distributions derived from measurements of the radial and time dependence of the three components of magnetic field showed a helical notch (screw thread) of reduced current density which rotated with uniform angular velocity. The pitch and apparent rotational frequency of the oscillation depended on the gas density, discharge current, and applied axial magnetic field; the right- or left-handedness and rotational sense depended on the relative orientation of the applied axial magnetic field and the self field of the discharge current. The helical regularity could be described as a superposition of hydromagnetic waves travelling in the axial and circumferential directions.

538.3 : 532.5 : 534.222.2

3656. MAGNETOHYDRODYNAMIC FLOW IN A SHOCK TUBE.
M.Mitchner.
Phys. of Fluids, Vol. 2, No. 1, 62-71 (Jan.-Feb., 1959).

The effect of a transverse magnetic field on the motion of a perfectly conducting fluid in a shock tube is examined. A generalized form of the Riemann invariant for the continuous motion of such a fluid is combined with the conservation equations for a magnetohydrodynamic shock to obtain an exact description of the fluid motion in a shock tube in terms of arbitrary initial conditions. The fluids are assumed to have constant specific heat ratios. Qualitatively, the effect of the magnetic field is equivalent to that of a pressure, but quantitatively the effect is always greater than merely the hydrodynamic pressure equivalent of the appropriate Maxwell stress. A magnetic field in the high-pressure region alone can produce shocks having Mach numbers for typical laboratory conditions, of the order of hundreds, and in general is in agreement with available experimental results. A magnetic field in the low-pressure region results in weaker, but higher velocity shocks.

538.3

3657. MAGNETO-HYDRODYNAMICS OF A FINITE ROTATING DISK. K.Stewartson.
Quart. J. Mech. appl. Math., Vol. 10, 137-47 (1957).

An attempt is made to account for certain observations of Lehnert by considering the flow within an infinite shallow horizontal layer of mercury in a vertical magnetic field when part of the base is set in rotation. For a large magnetic field a steady solution is found wherein the mercury above the disk rotates bodily up to the edge of the disk while it is at rest in the region beyond. Above the edge there is a thin friction layer separating the two regions, above which the free surface is parabolic and plane. Although such a solution is in agreement with Lehnert's observations, it is found that for the theory to be applicable the magnetic field should be considerably greater than the highest value he used. Accordingly, the problem is considered afresh with the magnetic field absent. A qualitively similar steady solution is derived numerically. Since it is known on experimental grounds that the flow in the friction layer is likely to be unstable, and on theoretical grounds that magnetic fields tend to stabilize such motions, it is inferred that the motions observed were in accord with the field-free theory but that the magnetic fields were necessary to ensure stability. Mathematical Reviews

538.3 : 532.5 : 536.25

3658. FLUID MOTIONS IN A SPHERE. I. THERMAL INSTABILITY OF A ROTATING FLUID SPHERE HEATED WITHIN.
T.Namikawa.
J. Geomagn. Geoelect., Vol. 9, No. 4, 182-92 (1957).

A fluid with negligible viscosity is examined. It is found that stationary convections cannot exist. Instability first sets in as overstability.

538.3 : 532.5 : 536.25

3659. FLUID MOTIONS IN A SPHERE. II. THERMAL INSTABILITY OF A CONDUCTING FLUID SPHERE HEATED WITHIN UNDER A UNIFORM MAGNETIC FIELD. T.Namikawa.
J. Geomagn. Geoelect., Vol. 9, No. 4, 193-202 (1957).

Axially symmetric steady state solutions exist and only $(U_n{}^m, V^m{}_{n+1}, \ldots.)$ motions can arise. Calculation suggests a relation between perturbations in the magnetic field and vorticity. Under normal terrestrial conditions, instability arises as ordinary cellular convections, but under astrophysical conditions, it can arise (depending on intensity of the uniform magnetic field) as cellular convection or as overstability oscillations of increasing amplitude.

538.3 : 532.5 : 536.25

3660. FLUID MOTIONS IN A SPHERE. III. THERMAL INSTABILITY OF A ROTATING FLUID SPHERE HEATED WITHIN UNDER A UNIFORM MAGNETIC FIELD. T.Namikawa.
J. Geomagn. Geoelect., Vol. 9, No. 4, 203-9 (1957).

The influence of simultaneous action of Coriolis force and magnetic field on convection is examined. It is found that there is only axially symmetric solutions of the marginal stability, and inhibition of convection by a magnetic field is pronounced when the intensity of magnetic field is larger than a critical value.

538.3 : 532.5 : 523.87

3661. EXAMPLES OF GAS MOTION AND CERTAIN HYPOTHESES ON THE MECHANISM OF STELLAR OUTBURSTS. L.I.Sedov.
Rev. mod. Phys., Vol. 30, No. 3, 1077-9 (July, 1958).

Some exact solutions of the equations of gas dynamics are presented: (1) a spherically symmetric radial motion of a self-gravitating gas with $\gamma = 7/6$, in which a shock wave of radius $\propto t^{5/6}$ expands into a stationary region. The energy of the motion is constant; (2) a cylindrically symmetric unsteady radial motion of a conducting gas in a magnetic field. The solution contains one arbitrary function if there is no self-gravitation, and seven arbitrar constants if there is self-gravitation; (3) a steady, cylindrically symmetric supersonic motion of a conducting gas deflected by a magnetized cone. All the magnetic field is pushed into a stagnant region next to the cone, separated from the flowing gas by a conical surface. O.Penrose

538.3 : 532.5 : 551.59

LARGE AMPLITUDE HYDROMAGNETIC WAVES ABOVE THE IONOSPHERE. See Abstr. 3013

538.31 : 53.084 : 621-526 : 621.317.2 : 621.318.5

IMPROVED MAGNETIC SUSPENSION SYSTEM.
See Abstr. 3086

538.53 : 537.56

INSTABILITIES OF A CYLINDRICAL GAS DISCHARGE WITH FIELD PENETRATION. See Abstr. 3593

ELECTROMAGNETIC WAVES AND OSCILLATIONS

538.561 : 621.374.4 : 621.375.9

3662. A THREE-FREQUENCY ELECTRON BEAM PARAMETRIC AMPLIFIER AND FREQUENCY CONVERTER. W.H.Louisell.
J. Electronics and Control, Vol. 6, No. 1, 1-25 (Jan., 1959).

The principle of varying a circuit reactance to produce gain is applied to an electron beam. The beam is modulated by an r.f. wave at frequency ω and this supplies energy to a signal at frequency ω_1 and an idler at frequency ω_2 which is generated in the beam, where $\omega = \omega_1 \pm \omega_2$. It is found that when $\omega = \omega_1 + \omega_2$, the signal idler grow exponentially while if $\omega = \omega_1 - \omega_2$ power is continuously converted from ω_1 to ω_2 and back to ω_1. For finite size beams, a current modulation threshold must be exceeded to produce growing waves. For the zero thickness beam no such threshold is observed. The growing waves are found to be fast space charge waves for a range of values of the signal to idler frequency ratio in contrast with conventional amplifiers which amplify slow waves and it is the latter class to which minimum noise figure theorems apply. The Manley—Rowe relations are verified for the parametric beam and the gain per unit length is found analytically. Finally, boundary conditions are applied. It is found that when the excitation is a fast wave and $\omega_1 \neq \omega_2$, power is growing and decaying waves are excited equally, independent of the phase of the pump relative to the signal. Approximate analytic expressions are found for the propagation constants and the boundary conditions using Pierce's coupled mode theory.

538.561 : 538.652 : 621.375.9

3663. MAGNETOACOUSTIC RESONANCE IN YTTRIUM IRON GARNET. E.G.Spencer and R.C.LeCraw.
Phys. Rev. Letters, Vol. 1, No. 7, 241-3 (Oct. 1, 1958).

A small crystal of yttrium iron garnet placed in a microwave cavity produced a 9 Mc/s signal, which is shown by a series of experiments to be an acoustic resonance of the crystal. The effect is explained in terms of magnetostriction and parametric amplification, the d.c. field for acoustic resonance being the field required for uniform precessional resonance at the idler frequency.

R.C.Kell

538.561 : 621.375.9

3664. MASER ACTION IN THE REGION OF 60°K. C.R.Ditchfield and P.A.Forrester.
Phys. Rev. Letters, Vol. 1, No. 12, 448-9 (Dec. 15, 1958).

Previously maser applications have been limited by the need to maintain liquid helium temperatures and this extension to the liquid-air region is of practical importance. It also indicates that the relaxation time in ruby is less temperature sensitive than was supposed. At 56°K a 3 cm amplifier with a gain of 30 dB and a gain–bandwidth product of 3.8 Mc/s was achieved. D.Walsh

538.561 : 529.786 : 621.317.39

COMPARISON OF AN AMMONIA MASER WITH A CAESIUM ATOMIC FREQUENCY STANDARD. See Abstr. 3078

538.565 : 537.54 : 621.372.413

3665. COUPLING OF RESONANT CAVITIES BY RESONANT COUPLING DEVICES. P.D.Dunn, C.S.Sabel and D.J.Thompson.
Atomic Energy Res. Establ. (Harwell) Rep. GP/R1966, 20 pp. (1956).

It is shown that the degree of coupling between cavity resonators can be considerably increased by resonating the coupling device, and a method is given of realizing this in practice. A theory is given for loss free structures and is in agreement with the experimental evidence. The theory is extended to take account of the modification of the dispersion characteristic in the cut-off frequency regions due to the introduction of loss. It is shown that by using this theory it is possible to predict the frequency behaviour of π-mode structures from measurements on single elements.

538.565 : 537.54 : 621.372.413

3666. PERTURBATION OF A RESONATOR. L.B.Mullett.
Atomic Energy Res. Establ. (Harwell) Rep. G/R 853, 18 pp. (1957).

The experiments which may be performed with a resonator are briefly described. Formulae are obtained for the various characteristics of a travelling wave system in terms of the data obtained from a resonant system. For complex systems of fields it is necessary to use complex shapes for the perturbing body. The most useful formulae are either derived, or quoted from existing literature for dielectric and metallic ellipsoids.

538.565 : 621.317.336

3667. MICROWAVE DOUBLE-SWEEP METHOD FOR ANALYSIS OF TIME-DEPENDENT CAVITY CHARACTERISTICS. S.Ruthberg.
Rev. sci. Instrum., Vol. 29, No. 11, 999-1003 (Nov., 1958).

The impedance of a microwave cavity whose characteristics are time-dependent, as caused for example by a contained gaseous discharge afterglow, can be examined by means of a frequency-modulated search signal and a swept receiver. The intersection of the search-signal frequency and the acceptance frequency of the receiver results in a pulse whose shape is sensitive to cavity resonance. The time of occurrence of the pulse depends upon signal-to-receiver phase. This in combination with the measured receiver dispersion allows measurement of reflection coefficient and frequency shifts smaller than the readability of a precision wavemeter at 10 kMc/s. Problems of oscillator tuning are mitigated and special stabilization procedures are eliminated. Only standard components are used.

538.566

3668. ON THE BOUNDARY CONDITION AT EDGES. P.Poincelot.
C.R. Acad. Sci. (Paris), Vol. 247, No. 25, 2312-13 (Dec. 22, 1958).
In French.

This note examines the uniqueness of the solutions discussed in a previous paper (Abstr. 8945/1958). P.M.Davidson

538.566 : 534.24

3669. ON THE DIFFRACTION AND REFLECTION OF WAVES AND PULSES BY WEDGES AND CORNERS. F.Oberhettinger.
J. Res. Nat. Bur. Stand., Vol. 61, No. 5, 343-65 (Nov., 1958).

Various problems arising in the theory of the excitation of a perfectly reflecting wedge or corners by a plane, cylindrical, or spherical wave, are dealt with. The incident wave is represented by a line source (acoustic or electromagnetic) parallel to the edge. The spherical wave is emitted by an acoustic point source or by a Hertz dipole with its axis parallel to the edge. The case of an incident plane wave field is obtained as the limiting case (for large distances of the source from the edge) of the cylindrical or spherical wave excitation.

538.566 : 621.396.8

3670. ON THE STATISTICAL CHARACTER OF THE SCATTERING OF CENTIMETRE WAVES BY AN AGITATED SEA-SURFACE.
S.Ya.Braude, N.N.Komarov and I.E.Ostrovskiĭ.
Radiotekhnika i Elektronika, Vol. 3, No. 2, 172-9 (1958). In Russian.

A theoretical treatment of the signal received in terms of a direct wave, a wave reflected from a plane surface and components produced by surface irregularities, with the frequency of the last group of terms different from the original wave. J.M.Hough

538.566

3671. THE PLANE DIFFRACTION PROBLEM FOR THE PARABOLIC CYLINDER OF FINITE EXTENSION.
G.A.Grinberg and Yu.V.Pimenov.
Zh. tekh. Fiz., Vol. 28, No. 10, 2302-9 (1958). In Russian.

The diffraction of electromagnetic waves on infinitely thin ideal conducting screens of finite extension is treated for short wavelengths. The results obtained are applied to the case of a parabolic cylinder and it is shown that even for relatively long wavelengths the radiation is directional. P.Roman

538.566.2

3672. ON THE PROPAGATION OF NON-SINUSOIDAL WAVES IN AN IONIZED GAS SUBJECTED TO A MAGNETIC FIELD.
M. De Socio.
Atti Accad. Sci. Torino I, Vol. 92, No. 2, 243-55 (1957-58).
In Italian.

Plane electromagnetic waves of small amplitude, damped by electron–ion collisions and moving either parallel or perpendicular to a constant externally applied magnetic field, are considered. A Laplace transform method yields the formal solution for the electric field when waves propagate into an initially quiescent region. The discontinuities in the time derivatives of the electric field at the wave front (travelling at the speed of light) are examined.

O.Penrose

538.566.2

3673. ON THE OBLIQUE PROPAGATION OF NON-SINUSOIDAL WAVES IN AN IONIZED GAS SUBJECTED TO A MAGNETIC FIELD.
M. De Socio.
Atti Accad. Sci. Torino I, Vol. 92, No. 2, 383-94 (1957-58).
In Italian.

The problem treated in a previous paper (see preceding abstract) is generalized to arbitrary directions of propagation.

O.Penrose

538.566.2 : 621.396.8

3674. AIR-MASS REFRACTIVITY IN CENTRAL CANADA.
D.R.Hay.
Canad. J. Phys., Vol. 36, No. 12, 1678-83 (Dec., 1958).

A study of air temperature, humidity, and pressure profiles above Maniwaki, Quebec, for the year 1957 shows that the four types of air mass have distinctive e.m. wave refractivities. It is shown also that the air masses may be identified through their dry and total refractivities. For a typical air-to-ground communication path, the mean effective-earth's radius varies from 1.26 to 1.37 times the true radius for the four types of air mass.

538.566.2 : 523.5

3675. ELECTROMAGNETIC SCATTERING BY LOW-DENSITY METEOR TRAILS. H.Brysk.
J. geophys. Res., Vol. 63, No. 4, 693-716 (Dec., 1958).

Expressions for the scattering of electromagnetic radiation by a meteor trail have been derived for a simple model. A uniform line density of electrons is first considered, of sufficiently low density that the interaction between electrons can be neglected. Then, the model is extended to include the effect of ambipolar diffusion. The fast initial penetration of the particles before they are slowed down to thermal velocities is taken into account. The derivations are based on an idealized superposition of aerial patterns with a constant gain within the coverage and a sharp cut-off; the extension to an arbitrary pattern is simple, and the procedure is sketched. Various limiting cases are considered, with careful specification of the realm of validity of approximations. The familiar expressions emerge in the large wavelength limit for specular scattering. Non-specular scattering and intermediate orientations are also treated. A small wavelength limit is derived, and the transition wavelengths are explored in detail.

538.566.3

3676. THE INTERPRETATION OF NIGHT-TIME LOW-FREQUENCY IONOGRAMS. J.M.Watts.
J. geophys. Res., Vol. 63, No. 4, 717-26 (Dec., 1958).

Two types of retardation of the extraordinary ray on passing through a region whose critical frequency is below the gyro-frequency are discussed. On a sweep-frequency basis, one is observed near the critical frequency of the ordinary ray and the other appears near the gyro-frequency. Observations of either require near transparency of the lower E-region during the night, but information as to the total number and distribution of electrons below the F-layer can be deduced from them.

538.566.3

3677. OBSERVATION OF VERTICAL-INCIDENCE SCATTER FROM THE IONOSPHERE AT 41 Mc/sec. K.L.Bowles.
Phys. Rev. Letters, Vol. 1, No. 12, 454-5 (Dec. 15, 1958).

The possibility of detecting incoherent scattering from electrons in the ionosphere is discussed. The scattered radiation will show large Doppler broadening (100 kc/s) if it occurs from independent electrons and a smaller broadening if from aggregates of electrons. A radar equipment operating at 40.92 Mc/s with peak power 4 to 6 MW and a beamwidth of about 4° directed at the zenith was used in a preliminary investigation of this phenomenon. The author suggests that echoes observed at 350 km range were of the incoherent scatter type. R.D.Davies

538.66 : 537.311.33

THERMOMAGNETIC EFFECTS OF NON-POLAR ISOTROPIC SEMICONDUCTORS. See Abstr. 3452

NUCLEAR AND ATOMIC PHYSICS

539.1

3678. INTERNATIONAL CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY, (GENEVA, SEPTEMBER, 1958).
Nucleonics, Vol. 16, No. 9, 151 pp. (Sept., 1958).

A review of the papers submitted to the conference, treating them under twelve main headings. A bibliography of papers is included. Those on nuclear power showed that in U.K., Japan and Western Europe, large power reactor programmes would be carried out from 1960-1970, while in U.S.A., West Germany, Canada and Russia the emphasis would be on developing the most economical reactor. Papers on fusion reactors described research on plasma physics directed towards heating a mass of gas to temperatures of about 10^8 °K and confining it long enough to extract more energy than was expended in the process. Many different methods of confinement are described, together with the difficulties that result from instabilities and the effects of impurities especially those from the walls. Many devices have reached temperatures of a few million degrees and some neutrons, probably from thermonuclear reactions, have been produced. The U.S.A. programme includes the DCX machine in which a 600 keV molecular deuterium beam is trapped in a "magnetic mirror" region. The trapping is accomplished by dissociating the deuterium molecules in a carbon arc discharge running in a high vacuum. Another mirror machine is the "Pyrotron" in which the plasma is heated by compression. The "Stellerator" uses a discharge in a torus forming the secondary of a pulse transformer, a figure of eight twist in the torus contributing to stability. Several devices depend on the "pinch effect" of large current discharges in either linear or toroidal machines. The "Ixion" is a mirror machine in which the plasma is reflected by a radial electric field. Plasma injection devices enable "puffs" of highly ionized gas to be accelerated up to 5×10^6 cm/s. In the U.K. the pinch effect has been studied in linear and toroidal machines (Zeta and Sceptre). "Reactor projects" summarizes experience of a variety of reactor types including pressurized water, boiling water, sodium and gas cooled reactors.

New reactor concepts include a high temperature gas cooled reactor with fuel elements consisting of a homogeneous mixture of uranium and graphite sheathed in graphite and operating at 1000° C, a terphenyl cooled D_2O-moderated, natural uranium fuelled reactor and pulsed research reactors. Special instruments described include low background counters for C^{14} counting, a wide range of dosimeters for ranges from 10^4 to 10^{10} rads and spectrometers for measurement of human γ-activity. Numerous applications of scintillators include a method for absolute standardization of radioactive nuclides. New techniques for making such nuclides and for labelling compounds for tracer experiments are described. Research into the mechanism o damage by radiation included work on radiation effects in water, polymers and copper. Burnable poisons can be used to reduce reactivity changes in reactor cores: the effects of self-shielding and the use of poisons to improve the flux distribution are illustrated b examples. A section on fast reactors includes a summary of the physical characteristics of nine reactors, including a dilute carbide fuelled breeder reactor. A report of the operation of the Mk III cor in EBR I show it to be stable: the exact cause of the instability in th Mk. I core has not been definitely established. Cross-section data showed improved accuracy and agreement compared with the 1955 values but some discrepancies still remain. These include the fissi cross-section of U^{235}, and the absorption cross-section of graphite and a number of important cross-sections in the resonance region. Partial capture cross-sections are also subject to some uncertainty despite many new measurements. Development of reactor fuels towards the production of elements to resist long burn-up at high temperature is reported, including the results of irradiation of uranium metal and uranium oxide at burn-ups up to 20%. The effect of radiation on the mechanical properties of structural materials is tabulate and some progress has been made towards an explanation of these effects in terms of migration of vacancies and the influence of dislocations. Graphite has received particular attention because of the problem of the stored Wigner energy. The compatibility of many materials with liquid sodium has been studied and the importance of reducing the oxygen content below 10 p.p.m. has been demonstrated. Irradiation damage to polyphenyls (of interest as reactor coolants) has been studied in detail. R.D.Smith

APPARATUS . PARTICLE DETECTORS

539.1.07

3679. THE USE OF ARGON AT ATMOSPHERIC PRESSURE AS GEIGER COUNTING GAS IN A WINDOWLESS COUNTER. S.Lovett.
J. sci. Instrum., Vol. 35, No. 11, 422-3 (Nov., 1958).

Describes in details the construction and use of argon—ethanol flow counter, using gas at a rate of 50 cm^3/min. at atmospheric pressure. The plateau extends from 1950 to 2250 V, with a slope of 3% per 100 V. J.M.Zarzycki

539.1.07

3680. A NEW LARGE-SURFACE FLOW-THROUGH COUNTER AS A MEANS TO THE BETTER DETERMINATION OF THE GROSS RADIOACTIVITY IN WATER AFTER THE EVAPORATION PROCESS. H.Kiefer and R.Maushart.
Nukleonik, Vol. 1, No. 3, 103-6 (Aug., 1958). In German.

Describes the design and characteristics of a windowless flow-through counter with an available counter area of 300 cm^2. An evaporation chamber is included in the counter, and the advantages of this arrangement are shown by comparing the results obtained with those of other methods. J.Dutton

539.1.07

3681. STUDIES OF SELF-QUENCHING COUNTER TUBES AT TEMPERATURES UP TO 350° C. G.Hagemann and E.Huster.
Nukleonik, Vol. 1, No. 3, 106-8 (Aug., 1958). In German.

Plateau characteristics for argon-hexane filled Geiger counters, using various cathode materials, are given for the temperature range 20-350° C. For an oxidized copper cathode, and the same gas filling, starting voltages are given for various filling pressures. J.D.Craggs

539.1.07

3682. ON GIANT PULSES PRODUCED IN ALCOHOL VAPOUR FILLED COUNTERS. S.Gürsey.
Rev. Fac. Sci. Univ. Istanbul C, Vol. 22, No. 3, 183-98 (July, 1957).

Describes a demountable Geiger counter used in the study of anomalously large pulses produced by Po α's in alcohol. Counter characteristics, plateaus, pulse sizes as a function of tube voltage etc. are given in detail. No explanation of the giant pulses is given. J.D.Craggs

539.1.07

3683. ANOMALOUS DISCHARGE COUNTERS AS DETECTORS OF COSMIC RAY NUCLEONIC COMPONENT. S.Akpinar.
Rev. Fac. Sci. Univ. Istanbul C, Vol. 22, No. 3, 243-55 (July, 1957).

The giant pulse counter described by Gürsey (see preceding abstract) has differential sensitivity and can discriminate between heavily ionizing particles and electron showers. Measurements were made on the intensity changes between sea level and 1900 m. Relative cross sections for nuclear interactions with Cu and Al were also measured. J.D.Craggs

539.1.07

3684. EXPERIMENTAL STUDY OF EXTERNAL CATHODE DETECTORS IN THE GEIGER-MÜLLER REGION.

A.M.Baptista, R.H.Cordeiro and J.P.Galvão.

Rev. Fac. Cienc. Univ. Lisboa B, Vol. 4, 5-18 (1955). In Portuguese.

Maze counters are described made of a special quality of glass and with some constructional simplifications. Their characteristics, which show zero plateau slopes extending to 3000 V, are discussed and interpreted. L.Pincherle

539.1.07

3685. NEW PROPORTIONAL COUNTERS FOR GASES AND VAPORS.

R.Wolfgang and C.F.Mackay.

Nucleonics, Vol. 16, No. 10, 69-73 (Oct., 1958).

A simple metal walled counter, a vapour flow counter and a window flow counter are described and their efficiencies compared with other types of β-counter. It is concluded that proportional counters are generally superior for flow counting at temperatures up to 500°C. R.D.Smith

539.1.07

3686. BORON TRIFLUORIDE NEUTRON COUNTERS TYPE NUM-12, NUM-30, NUM-72, NUM-12 W, NUM-30 W, NUM-72 W.

A.Kazimierski.

Nukleonika, Vol. 3, No. 5, 599-605 (1958). In Polish.

Describes with details conventional proportional neutron counters of two types: a) with natural BF_3; b) with B^{10} enriched BF_3 (length 12 cm, 30 cm, 72 cm). Graphs of variation of counting rate and gas amplification with voltage are given. J.M.Zarzycki

539.1.07

3687. COUNTING RATES IN BF_3 ARGON CHAMBERS.

N.Miller.

Atomic Energy Canada Rep. 112, 5 pp. (Jan. 17, 1954).

A set of experiments were carried out in which an ionization chamber maintained in a constant thermal neutron flux was filled successively with mixtures of BF_3 and argon of various concentrations and at various total pressures. The following points were proved. (1) The counting rate in the chamber was proportional within 2% to the partial pressure of boron trifluoride irrespective of the total pressure of the mixture. (2) The mixing of the two gases by diffusion was very slow; 7 days standing being required within the apparatus used before the counting-rate became constant after mixing. (3) No significant separation of the two gases occurred when a mixture was suddenly admitted to the evacuated chamber through a narrow capillary.

539.1.07

3688. THE CALCULATION OF LINE SHAPES IN UNGRIDDED IONIZATION CHAMBERS AND ITS USE TO EVALUATE THE IONIZATION PRODUCED BY LIGHT RECOIL NUCLEI IN THE RANGE BELOW 1.5 MeV.

J.C.D.Milton, A.R.Rutledge and P.I.K.Lennox.

Atomic Energy of Canada Rep. 331, 40 pp. (June, 1956).

The theory of the expected line shapes in ungridded, fast collection ionization chambers is worked out and the result obtained in closed form, provided a simple assumption is made for the analytic form of the range—energy relation. The theory is otherwise completely rigorous. The assumption that range is proportional to energy does not make any serious errors for low-energy particles ($1 < E_\alpha < 3$ MeV) in all practical cases. The theory is applied to the data obtained by DeJuren and Rosenwasser (Abstr. 4947/1954) for the ionization produced by the resulting particles in the $B^{10}(n,\alpha)Li^7$ reaction, and it is concluded that

$$\frac{\text{Ionization of } \alpha}{\text{Ionization of Li}} = 1.854 \pm 0.020,$$

whereas the ratio of the energies is 1.753.

539.1.07

3689. USE OF A DERIVATIVE OF COUMARIN AS A SECONDARY SOLUTE IN LIQUID SCINTILLATORS.

A.Coche, R.Henck and G.Laustriat.

C.R. Acad. Sci. (Paris), Vol. 247, No. 23, 2123-6 (Dec. 10, 1958).

In French.

539.1.07

3690. ON THE APPLICABILITY OF ^{4}He GAS SCINTILLATORS AS ANALYZERS OF NEUTRON ENERGY AND POLARIZATION.

C.Rubbia and M.Toller.

Nuovo Cimento, Vol. 10, No. 2, 410-11 (Oct. 16, 1958).

An He^4 gas scintillation counter was used to count Po^{210} α-particles. The pulse height did not vary more than 10% in the pressure interval 20-100 atm at 20, 0, and −60°C. At 25°C the pulse height dropped 50% during a week; at 0°C no change was found. About 1400 photons reached the cathode of the photomultiplier per MeV lost by the particle in the gas. Application as a neutron polarimeter is discussed. P.G.Murphy

539.1.07 : 535.376

LIQUID SCINTILLATORS: ATTRIBUTES AND APPLICATIONS. See Abstr. 3326

539.1.07 : 535.376

QUENCHING OF LIQUID-SCINTILLATOR SOLUTIONS BY ORGANIC COMPOUNDS. See Abstr. 3327

539.1.07 : 535.376

LIQUID SCINTILLATORS CONTAINING METALLIC IONS. See Abstr. 3330

539.1.07 : 535.376

A MATRIX TO CORRECT FOR SCINTILLATOR ESCAPE EFFECTS. See Abstr. 3332

539.1.07

3691. GAMMA-RAY RESOLUTION OF LARGER NaI(Tl) SCINTILLATORS.

R.L.Hickok and J.E.Draper.

Rev. sci. Instrum., Vol. 29, No. 11, 994-9 (Nov., 1958).

The various factors affecting the gamma-ray energy resolution of NaI(Tl) scintillation spectrometers were investigated experimentally with commercially packaged 2.5 and 5 in. diam. scintillators and routinely available 3 and 5 in. photomultipliers. The resolution contains contributions from the scintillator light yield, photocathode efficiency, intrinsic resolution due to the material NaI(Tl) and two terms involving the effects of various spatial inhomogeneities in the packaged scintillator and photomultiplier. Insofar as possible these contributions were experimentally separated. The poorer resolution of the 5 in. systems is in about equal measure caused by their smaller light yield, their larger spatial inhomogeneities and the lower efficiency of the 5 in. photomultipliers in producing and collecting cathode electrons.

539.1.07

3692. ION IDENTIFICATION WITH THE SCINTILLATION DETECTOR IN MASS SPECTROSCOPY.

E.Schönheit.

Z. Naturforsch., Vol. 11a, No. 10, 819-23 (1956). In German.

A scintillation counter is applied to the detection of ions with low intensity, a ZnS—Ag screen being used in conjunction with a 931A R.C.A. photomultiplier. G.F.J.Garlick

539.1.07

3693. DETECTION OF HIGH ENERGY μ-MESONS BY AN AIR ČERENKOV COUNTER.

R.Giacconi, W.Blum and G.T.Reynolds.

Nuovo Cimento, Vol. 11, No. 1, 102-7 (Jan. 1, 1959).

An investigation of the properties of air Cherenkov counters is described. A quantitative interpretation of the results is given.

539.1.07

3694. ABSOLUTE MEASUREMENTS ON β-EMITTING RADIONUCLIDES. COUNTERS WITH SOLID ANGLE OF 4π.

A.M.Baptista.

Rev. Fac. Cienc. Univ. Lisboa B, Vol. 4, 95-180 (1955).

In Portuguese.

Mainly a review, but with original contributions; thus a new detector is described and its performance discussed, and a new method is suggested for the preparation of β-standards of RaE. L.Pincherle

539.1.07

3695. COUNTING LOSSES DUE TO THE STATISTICAL NATURE OF THE PHOTOELECTRIC EFFECT IN A SCINTILLATION 4π-COUNTER FOR β-EMITTERS.

M.Yu.Tissen.

Zh. tekh. Fiz., Vol. 28, No. 7, 1617-20 (1958). In Russian.

The losses are calculated on the assumption that the photoelectric emission may be described by a Poisson distribution. Results of calculations of losses for a counter consisting of two photomultipliers in coincidence are in good agreement with experiment. S.Chomet

539.1.07

3696. PALLADIUM FILM DOSIMETER. H.M.Childers.
Rev. sci. Instrum., Vol. 29, No. 11, 1008-10 (Nov., 1958).

A PdO film electrical resistor (see Abstr. 5314/1950), mounted on an insulating base and surrounded with a hydrogenous material, was investigated for use as a neutron dosimeter. It was found that the resistance of such film was lowered from several thousand to a few ohms upon being irradiated either in a reactor or in a pure gamma-ray field. The cause of this resistance change was determined to be the evolution of hydrogen gas during irradiation, which reduced the PdO to Pd. The potential use of this device as a total dose dosimeter is discussed. Dosimeters were constructed by placing a film of palladium resinate solution on insulating cylindrical bases of approximately $\frac{1}{4}$ in. diameter and 1 in. long. The films were then fired in an oxygen atmosphere for $\frac{1}{2}$ hour or more at temperatures ranging from 500°C to 700°C. The resultant dosimeters were then silvered on the ends to provide electrical contacts and appropriately coated.

539.1.07 : 578.088.5

3697. POLYMER DEGRADATION — WIDE-RANGE DOSIMETER. P.Y.Feng.
Nucleonics, Vol. 16, No. 10, 114 (Oct., 1958).

An organic solution of a polymer such as polystyrene is proposed for use as a dosimeter. By measuring the change in viscosity a system useful over 4 decades in the range 10^2-10^6 rads should be possible. R.D.Smith

539.1.07 : 578.088.5

3698. PHOTOVOLTAIC GAMMA-RAY DOSIMETER.
J.W.Moody, G.L.Kendall and R.K.Willardson.
Nucleonics, Vol. 16, No. 10, 101-2 (Oct., 1958).

A silicon solar cell consisting of a n—p junction was irradiated with Co^{60} γ-rays and 60 kV X-rays and the voltage output measured as a function of radiation intensity. Output was linear over the range 10^2—10^7 rep/hr and the cell was sensitive up to 10^{10} rep/hr. R.D.Smith

539.1.07

3699. DISCRIMINATION BETWEEN γ-RAY BACKGROUND AND CHEMICAL BACKGROUND IN NUCLEAR EMULSIONS.
J.Bermond and M.Schérer.
C.R. Acad. Sci. (Paris), Vol. 247, No. 19, 1580-3 (Nov. 10, 1958). In French.

Reports optimum values of development time (42.5-53 min) for pH 7.1-6.6 for 50 μ G5 emulsions in amidol without KBr at 4°C. E.J.Burge

539.1.07

3700. THEORY OF DIFFUSION DURING THE PROCESSING OF THICK PARTICLE TRACK EMULSIONS. P.Demers.
Canad. J. Phys., Vol. 36, No. 6, 704-6 (June, 1958). In French.

The durations of the several stages in the processing of nuclear emulsions are shown to be approximately proportional to the square of the effective thickness, defined as the true thickness plus a constant between 25 and 100 μ. This agrees with experiment. E.J.Burge

539.1.07

3701. THE SCATTERING CONSTANT FOR MULTIPLY-CHARGED PARTICLES IN PHOTOGRAPHIC EMULSION.
C.Fichtel and M.W.Friedlander.
Nuovo Cimento, Vol. 10, No. 6, 1032-8 (Dec. 16, 1958).

Numerical values are calculated for the scattering constant for multiply charged particles in photographic emulsion. The constant is calculated both with and without cut-off being applied for correction for single scattering, and the results are presented in graphical form.

539.1.07

3702. DIFFUSION OF ^{214}Pb IN NUCLEAR EMULSIONS.
E.Frota-Pessôa and N.Margem.
Nuovo Cimento, Vol. 10, No. 6, 1039-48 (Dec. 16, 1958).

A study is made of the diffusion in nuclear emulsions of Pb^{214} and Bi^{214}. It is shown that the diffusing nuclide is Pb^{214} although a small diffusion of Bi^{214} is not excluded. The order of magnitude of the coefficient of diffusion of Pb^{214} is found to be 10^{-12} c.g.s. The percentage of non diffusing Pb^{214} atoms is found to be of the order of 50% in the examined plates.

539.1.07 : 539.12

3703. SPURIOUS SCATTERING OF 6.2 GeV PROTONS IN NUCLEAR EMULSIONS. F.W.Fischer and J.J.Lord.
Nuovo Cimento, Vol. 11, No. 1, 44-7 (Jan. 1, 1959).

Multiple scattering measurements of 6.2 GeV proton tracks in emulsion were carried out for cell lengths up to 10 000 microns. It was found that the spurious scattering contribution remained constant for cell lengths greater than about 3000 microns. Measurements on a group of parallel tracks showed that the region of the microscopic dislocations responsible for spurious scattering had dimensions on the order of 1 mm to 2 mm.

539.1.07

3704. GRAIN SIZE AND GRAIN DENSITY IN ILFORD K-5 AND L-4 EMULSIONS. R.C.Kumar.
Nuovo Cimento, Vol. 11, No. 1, 108-10 (Jan. 1, 1959).

Electron micrographs of grains in unprocessed and processed Ilford K-5 and L-4 emulsions are shown. The silver bromide grain sizes in the unprocessed K-5 and L-4 plates were measured and found to be normally distributed with mean values of (0.210 ± 0.007) μm and (0.134 ± 0.004) μm and standard deviations of 0.035 μm and 0.021 μm respectively. The electron micrographs of the silver grains in processed emulsions reveal absence of spherical shape or solid structure in case of most of these grains. The grain densities on plateau ionization tracks were found to be approximately the same in K-5 and L-4 plates as in G-5 plates processed under similar conditions. The L-4 plates however are subject to more serious fading with delay in processing after exposure than the K-5 or G-5 ones.

539.1.07 : 535.823.51

MICROSCOPE MECHANICAL OBJECT STAGE FOR THE STUDY OF THE TRACKS OF CHARGED PARTICLES IN PHOTOGRAPHIC EMULSIONS OR OTHER OBJECTS IN TRANSPARENT MEDIA.
See Abstr. 3367

539.1.07

3705. A COINCIDENCE SPECTROMETER FOR NUCLEAR PHYSICS RESEARCH. P.Weinzierl, R.Patzelt and H.Warhanek.
S.B. Österr. Akad. Wiss. mat.-nat. Kl. Abt. II, Vol. 165, No. 5-7, 169-77 (1956). In German.

An arrangement for nuclear measurements is described, which through the combined use of a fast coincidence stage and a slow three-fold coincidence circuit allows resolving times down to 10^{-8} seconds. Pulse gating before the single-channel analyser lengthens the pulse and improves the accuracy of the measurements. The efficiency of the arrangement can be best exploited with scintillation counters although the use of ionization chambers and proportional counters is also possible. Mechanical construction and stability of the apparatus are briefly discussed. I.C.Demetsopoullos

539.1.07

3706. THE ELECTRON LINEAR ACCELERATOR AS A PULSED RADIATION SOURCE. M.G.Kelliher, J.C.Nygard and A.J.Gale.
I.R.E. Trans Nuclear Sci., Vol. NS-3, No. 3, 1-7 (June, 1956).

One of the inherent properties of the electron linear accelerator is that is produces radiation in pulses whose duration is less than the pulse duration of the radio frequency source from which it is fed. In practice the pulse length lies in the range from 1 to 5 μsec. However, by independent pulsing the electron source or injector, intense pulses of radiation of duration 0.1 μsec or less can be easily achieved and the lower limit is set only by stray capacitance effects. The radiation produced can be electrons, X-rays, or neutrons by (γ—n) reaction .

539.1.07

3707. ATTEMPTS FOR THE ENHANCEMENT OF THE NEUTRON YIELD FROM A DEUTERON—ACCELERATOR WITH HEAVY ICE AND TRITIUM TARGETS. H.Münzer.
S.B. Osterr. Akad. Wiss. mat.-nat. Kl. Abt. II, Vol. 165, No. 5-7, 267-71 (1956). In German.

The reactions $D^2(d,n)He^3$ and $T^3(d,n)He^4$ are induced by the 200 kV accelerator described elsewhere (see Abstr. 3588/1959) and the dependence of the neutron yield on various factors is investigated. With a current of 110 μA at 150 kV a neutron yield of 3.10^9n/sec was achieved using a zirconium—tritium target. Since the target can withstand a dissipation of up to 100 W/cm^2 the yield may be increased by a factor of 4 or 5 by increasing the ion current. In the case of the D—D reaction a yield of $1:5.10^8$n/sec was obtained (250 μA, 200 kV) but it was not found possible to maintain constancy in time. With a target current of 300 μA and 200 kV accelerating voltage the decrease was about 25% in a quarter of an hour. It is therefore necessary to renew the ice-layer at known intervals of this order. P.K.Kabir

539.1.07 : 539.12

3708. DETECTION OF FAST NEUTRONS BY THE ASSOCIATED PARTICLE METHOD.
P.L.Okhuysen, E.W.Bennett, J.B.Ashe and W.E.Millett.
Rev. sci. Instrum., Vol. 29, No. 11, 982-5 (Nov., 1958).

The associated particle method of neutron detection was used to reduce the background in measurements of the total cross-section using neutrons from the D(d,n)He^3 reaction and to measure the time-of-flight of the neutrons that are inelastically scattered when elements are bombarded with T(d,n)He^4 neutrons. The techniques used are described.

ELEMENTARY PARTICLES

539.12

3709. A SIMPLE FORMULATION OF THE ELEMENTARY PARTICLE SCHEME OF GELL-MANN AND NISHIJIMA.
M.Kretzschmar.
Nuovo Cimento, Vol. 8, No. 6, 949-50 (June 16, 1958).

Reformulates this classification scheme in a space of three dimensions, corresponding to electrical charge, hypercharge and baryon number. R.J.N.Phillips

539.12

3710. ONE POSSIBILITY OF BARYON CLASSIFICATION.
Kh.Ȳiglane.
Zh. eksper. teor. Fiz., Vol. 33, No. 6(12), 1537-8 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 6(33), No. 6, 1189-90 (June, 1958).

539.12

3711. ON THE CLASSIFICATION OF THE NEW PARTICLES.
R.L.Ingraham.
Nuovo Cimento, Vol. 10, No. 6, 1060-70 (Dec. 16, 1958).

The types of new quantum numbers for elementary particles which result from extending L_{inh} (inhomogeneous Lorentz group) to a larger symmetry group which is not simply $L_{inh} \times$ isotopic rotations are investigated. The main results are (a) there is another spin having nothing to do with Lorentz transformations, of the type of isotopic spin; (b) each irreducible representation of the group comprises a finite family of conventional particles with a certain spectrum of spins; the spectrum of the z-component of this "ultra-Lorentz" spin is related to the spin spectrum in a definite way; (c) a structure like the empirical division of all particle families into the class of those which coincide with their anti-particle families and the class of those whose antiparticles form different families is found; (d) a revision of the concept of bare particle mass is implied.

539.12

3712. ON THE EXPONENTIAL APPROXIMATION IN PARTICLE DECAYS. G.Höhler.
Z. Phys., Vol. 152, No. 5, 546-65 (1958). In German.

The validity-limit of the approximation leading to an exponential decay law is studied in the framework of the simple model of a two-particle decay. The exact solution of the initial-value problem may be reformulated so that the exponential approximation can be separated off in an additive manner. It belongs to a pole in the analytic continuation of the expectation value of the resolvent $(\lambda - H)^{-1}$. The additional term to the exponential law decreases by a power-law and determines thus the asymptotic behaviour. In the case of reasonable coupling schemes with a weak interaction no measurable effects can be expected. For stronger interactions the deviation from the exponential law depends sensitively on the exact form of the coupling and first one has to clear up the meaning of a short-lived unstable particle. P.Roman

539.12

3713. ELECTROMAGNETIC MASS CORRECTION FOR SPIN 0 PARTICLES. S.Gasiorowicz and A.Petermann.
Phys. Rev. Letters, Vol. 1, No. 12, 457-8 (Dec. 15, 1958).

It is claimed that this mass correction, in lowest order, indicates the relation

$$(m_{K^+} - m_{K^0})/(m_{\pi^+} - m_{\pi^0}) = m_\pi/m_K$$

for the π- and K-meson masses. Non-electromagnetic interactions are expected not to alter this result greatly. R.J.N.Phillips

539.12 : 539.1.07

3714. CLOUD CHAMBER SEARCH FOR PARTICLES IONIZING LESS THAN AN ELECTRON.
H.C.Fitz,Jr, W.B.Good, J.L.Kassner,Jr and A.E.Ruark.
Phys. Rev., Vol. 111, No. 5, 1406-16 (Sept. 1, 1958).

Since ionization due to a charged particle varies with the square of its charge, a very clean cloud chamber can be used to search for particles having charges, ze, much less than the electronic charge. Similar remarks hold true for magnetic monopoles of relativistic speed. A horizontal cloud chamber constructed by J.A.Bearden was employed, in the gamma flux from a radium source, to search for such particles. The sensitive time was about 1.5 sec. The background was at least 60 times less than values commonly reported for "clean" chambers. No subionizers with z in the range $\frac{1}{8}$ to $\frac{1}{2}$ were seen during a time in which about 900 electron tracks were recorded, one million gamma rays traversed the chamber, and 3 million disintegrations were available to give rise to such particles. A vertical chamber 12 in. high was used to look for subionizers in the cosmic ray flux. The background ranges from 0.05 to 1.0 drop per cc, with a usable sensitive time of 0.3 seconds. Technique for a more limited search was developed; use was made of the fact that background drops are single and well separated, while there are many clumps of ions along a track. No subionizers appeared in a body of photographs containing 550 electron and μ-meson tracks. It was shown by study of "ghost tracks" that neutral nuclei are a major source of the background commonly encountered in tall chambers.

539.12

3715. TESTS FOR THE SPIN IN THE DECAY OF PARTICLES OF ARBITRARY SPIN.
L.Durand, III, L.F.Landovitz and J.Leitner.
Phys. Rev., Vol. 112, No. 1, 273-82 (Oct. 1, 1958).

The polarization and angular distribution of a spin-$\frac{1}{2}$ particle produced in the decay of a fermion of arbitrary spin into two particles of spins 0 and $\frac{1}{2}$, and in the decay of a boson of arbitrary spin into two different spin-$\frac{1}{2}$ particles, one of which is a two-component neutrino, are calculated in terms of the general decay amplitudes. The results are applied to the discussion of tests for the spin of the decaying particle. Restrictions on the possible spins are found in terms of inequalities limiting the values of certain test functions applied to the experimental angular distributions and polarizations. The results for the boson decay are used in a discussion of the spin of the $K_{\mu 2}$ and of the possibility of lepton conservation in the $K_{\mu 2}$ and $\pi - \mu$ decays. A limit of 10% nonconservation of leptons is found if the K spin is 0. Application of the spin tests to the decay of the Λ^0 hyperon provides substantial evidence that the Λ^0 spin is $\frac{1}{2}$.

539.12

3716. ENERGY LOSS OF FAST CHARGED PARTICLES IN LiH.
W.Brandt.
Phys. Rev., Vol. 111, No. 4, 1042-6 (Aug. 15, 1958).

The quantum theory of the electromagnetic interaction of particles and fields in dense matter predicts that fast charged particles lose their kinetic energy to longitudinal electron excitations influenced by one-electron and collective effects. Both effects are to be expected in metals and insulators, but to varying degrees. A clear identificiation of collective excitations in insulators is still lacking. LiH is the best-suited crystal for predicting the one-electron and collective effects on the longitudinal electronic excitations in an insulator, and for verifying such prediction experimentally. The characteristic energy loss spectrum and the mean excitation potential of the LiH crystal are estimated. One finds that the longitudinal excitations in this insulator crystal are of predominantly collective character. The results are so significantly different from those obtained by neglecting collective effects that stopping experiments in single as well as in multiple scattering can clearly identify the collective effects and confirm the theoretical predictions.

539.12 : 539.17

MULTIPLE PRODUCTION OF PARTICLES IN COLLISIONS BETWEEN FAST NUCLEONS AND NUCLEI. See Abstr. 2775

539.12

3717. ANGULAR ENERGY FLUX OF SECONDARY GAMMA-RAYS IN MATTER: SMALL-ANGLE SCATTERING FROM A POINT ISOTROPIC SOURCE. W.R.Dixon.
Canad. J. Phys., Vol. 36, No. 4, 419-30 (April, 1958).

The distribution in energy and angle of secondary gamma-rays in matter is studied, with particular reference to small angles and to energies near the incident energy. The "angular energy flux" arising from a point isotropic source in matter is calculated, using small-angle approximations, and compared with experimental data obtained for a Cs^{137} source in concrete. It is concluded that for small angles and for energies near the incident energy, only a few orders of scattering contribute to the angular energy flux out to considerable thicknesses, whereas for large angles and low energies many orders of scattering contribute even for small thicknesses.

539.12

3718. ON THE EFFECT OF MULTIPLE SCATTERING ON THE ATTENUATION OF γ-RAYS FROM EXTENDED SOURCES.

E.E.Kovalev and D.P.Osanov.
Zh. tekh. Fiz., Vol. 28, No. 7, 1610-12 (1958). In Russian.

The problem considered is that of an extended source of γ-rays covered by a shielding layer which absorbs and scatters. It is shown that multiple scattering in the shield, or the source itself, may be taken into account in those cases where analytical formulae are available for transmission and attenuation of γ-rays (truncated cone, disc, etc.). S.Chomet

539.12 : 530.145

EXPERIMENTAL DEMONSTRATION OF THE NON-CONSERVATION OF PARITY BY MEASURING THE CIRCULAR POLARIZATION OF γ-RAYS. See Abstr. 3109.

539.12 : 530.145

3719. ON THE RADIATION EMITTED BY CHARGED PARTICLES INTERACTING WITH COMPLEX NUCLEI. B.Bosco.

Nuovo Cimento, Vol. 10, No. 3, 563-6 (Nov. 1, 1958).

A bremsstrahlung calculation is outlined for a particle interacting with a complex nucleus via a complex potential. The current associated with the transition in the potential well determined only part of the radiation emitted, and more precisely, for not too high-energy protons, the electric multipole transitions. J.Lascoux

539.12

3720. ANGULAR DISTRIBUTION OF HIGH-ENERGY BREMSSTRAHLUNG. A.Deloff and R.Gajewski.

Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 6, No. 8, 529-31 (1958).

The angular distribution is derived using the Bethe—Heitler formula as a starting point and introducing a nuclear form factor to account for the charge distribution in the nucleus.
A.E.I. Research Laboratory

539.12

3721. LONGITUDINAL POLARIZATION OF BREMSSTRAHLUNG AND PAIR PRODUCTION. K.W.McVoy.

Phys. Rev., Vol. 111, No. 5, 1333-7 (Sept. 1, 1958).

The Born approximation bremsstrahlung (and pair production) cross-sections, valid at all energies and angles, are given for all possible states of longitudinal polarization of the particles involved. When the photon-incoming electron angle (θ_0) and the photon-outgoing electron angle (θ) are both zero, a cancellation of Feynman diagrams causes all cross-sections to vanish in Born approximation. Further, if both θ_0 and θ are small compared to m^2/E_0^2, the "spin-flip" cross-sections are small (of order θ^2) relative to the "non-spin-flip" ones. When account is taken of the above cancellation, angular momentum conservation is sufficient to determine this small-angle behaviour, but it explains neither the sign nor the magnitude of the bremsstrahlung circular polarization.

539.12

3722. HIGH-ENERGY BREMSSTRAHLUNG IN ELECTRON—PROTON COLLISIONS. R.A.Berg and C.N.Lindner.

Phys. Rev., Vol. 112, No. 6, 2072-6 (Dec. 15, 1958).

The cross-section for the bremsstrahlung resulting from high-energy collisions of electrons with protons is calculated, considering the electrons as extreme relativistic and taking into consideration the proton's recoil, anomalous magnetic moment, bremsstrahlung, and form factors. The final cross-section is integrated over the recoil proton and final photon to obtain a formula of interest for the Stanford accelerator experiments. The computation of the integrated cross-section, made without regard for radiative corrections and mesonic contributions, is estimated to be accurate to 2% in the energy ranges of interest. This cross-section is corrected for radiative effects, which produce an additional uncertainty of less than 5% and possibly as little as 1%. Resonance effects due to meson interactions in the "virtual Compton effect" diagrams, however, become significant in the range of interest. Their contribution to the cross-section is discussed.

539.1

3723. EVALUATION OF BREMSSTRAHLUNG CROSS SECTIONS AT THE HIGH-FREQUENCY LIMIT.

U.Fano, H.W.Koch and J.W.Motz.
Phys. Rev., Vol. 112, No. 5, 1679-83 (Dec. 1, 1958).

Recent experimental values for the bremsstrahlung cross-secti near the high-frequency limit with electron energies from 0.05 to 15 MeV and with target atomic numbers from 13 to 79 are compare with theoretical estimates. Calculations made to lowest order in Z/137 show large differences with the experimental results for larg Z. Improved estimates, derived by detailed balancing arguments from more accurate photoelectric cross-sections, agree reasonably well with the experimental results throughout the indicated range of electron energies and atomic numbers.

539.12

3724. CHERENKOV RADIATION AND ITS PRACTICAL APPLICATIONS. B.J.Wilson.

Atomic Energy Res. Establ. (Harwell) Inf. Bibl. 90, Suppl. 2, 12 pp. (1958).

A bibliography to supplement AERE Inf/Bibl. 90 (Abstr. 5697/1954) and Supplement (Abstr. 5398/1957).

539.12

3725. ON THE RELATION BETWEEN VELOCITY AND MASS OF THE ELECTRON. S.Raboy and C.C.Trail.

Nuovo Cimento, Vol. 10, No. 5, 797-803 (Dec. 1, 1958).

It is suggested that the elastic scattering of electrons from electrons be used to verify the Lorentz law of mass variation with velocity. The kinematics of such a process yield angular dependence which are sensitive to the model used. An independent measurement of the velocity of the incident particle is necessary to complete the measurement in a logical fashion. It is shown that two other experiments reported in the literature are deficient in this respect.

539.12

3726. SOME ATOMIC EFFECTS OF AN ELECTRONIC DIPOLE MOMENT. E.E.Salpeter.

Phys. Rev., Vol. 112, No. 5, 1642-8 (Dec. 1, 1958).

A parity-violating perturbation, corresponding physically to a permanent electric dipole moment of an electron parallel to its spin, is introduced into the Dirac equation for an electron. For positrons two choices of the relative sign of electric moment and spin are considered. Some numerical consequences of such a perturbation for hydrogenic atoms and for positronium are calculated. From various experiments carried out previously, rough upper limits are obtained for ξ, the electric dipole moment expressed in units of eh/mc: from the numerical value of the Lamb shift, $\xi < 0.004$; from the metastability of the 2s-state in hydrogen, $\xi < 0.03$. From the absence of $K \to L_i$ X-ray transitions in the heaviest atoms, the upper limit for ξ is about 0.005 or, probably, even smaller. From the value of the hyperfine splitting of the positronium ground state, $\xi < 0.02$.

539.12 : 537.591.15

ELECTRON NUMBER DISTRIBUTION IN ELECTRON—PHOTON SHOWERS. See Abstr. 3616

539.12

3727. MOMENTUM TRANSFER CROSS-SECTION IN THE THOMAS—FERMI THEORY. T.Tietz.

Nuovo Cimento, Vol. 10, No. 3, 531-3 (Nov. 1, 1958).

This is calculated for electron scattering in the first Born approximation using the Rozental (1935) approximation to the T—F function. J.Hawgood

539.12

3728. ELECTROMAGNETIC PROPERTIES OF THE NUCLEON AND RELATIVISTIC ELECTRON—PROTON SCATTERING ACCORDING TO MESON THEORY. L.K.Pandit.

Helv. phys. Acta, Vol. 31, No. 4, 379-412 (1958).

The relativistic cut-off theory of Arnous and Heitler (Abstr. 2644/1956) is used to calculate the anomalous magnetic moments of the nucleons and the elastic scattering of high energy electrons by protons on the basis of charge-symmetrical pseudoscalar meson theory, using both pseudoscalar and pseudovector couplings. The calculations are carried to the first order in perturbation theory. Good agreement is found with the experimental results of Hofstadter et al. on electron—proton scattering. The non-relativistic limit of the anomalous moments is studied and a discrepancy in the results of the usual non-relativistic meson theory models is pointed out and treated.

539.12

3729. RELATIVISTIC ELECTRON—NEUTRON SCATTERING ACCORDING TO MESON-THEORY. L.K.Pandit.

Nuovo Cimento, Vol. 10, No. 3, 534-7 (Nov. 1, 1958).

Extension of work described in preceding abstract. Using charge symmetrical PS theory in lowest order with either PS or PV coupling, and with suitable values for the cut-off and the coupling constant, the author is able to obtain reasonable agreement with both electron—neutron and electron—proton scattering results. The best agreement is obtained with $K_0 = {}^2/_3 M$ and $G^2/4\pi = 16$, which are also suitable values for fitting the charged and neutral pion mass difference and the results of pion—nucleon scattering.

E.J.Squires

539.12

3730. IMPROVED SUM RULE FOR ELECTRON—DEUTERON SCATTERING. R.Blankenbecler.

Phys. Rev., Vol. 111, No. 6, 1684-90 (Sept. 15, 1958).

A qualitative discussion of the approximations implicit in the present theoretical treatment of the deuteron is presented. An improved sum rule which relates the total elastic and inelastic scattering of electrons from the deuteron to the free electron—nucleon cross-sections is derived. It has the property of reducing to the correct relativistic result upon neglect of binding. It is proved that the use of folded nucleon and nuclear form factors is correct. It is shown that the finite nucleon size does not affect any real photon process.

539.12

3731. ELECTRON SCATTERING FROM THE DEUTERON AND THE NEUTRON—PROTON POTENTIAL.

J.A.McIntyre and G.R.Burleson.

Phys. Rev., Vol. 112, No. 6, 2077-86 (Dec. 15, 1958).

Electron scattering by the deuteron has been studied experimentally at 400 and 500 MeV. The results of the scattering are compared with the scattering expected by three different static deuteron models. All three models satisfy the usual deuteron requirements such as binding energy, effective range, quadrupole moment, and percent D-state. Two of the models have Yukawa neutron—proton potentials; the third has a repulsive-core potential. The experimental results agree with the repulsive-core model and disagree with the Yukawa models. This result applies only to the triplet-S neutron—proton potential.

539.12

3732. COLLISION CROSS SECTION AND ENERGY LOSS OF SLOW ELECTRONS IN HYDROGEN. G.Bekefi and S.C.Brown.

Phys. Rev., Vol. 112, No. 1, 159-64 (Oct. 1, 1958).

Values for the collision cross-section for momentum transfer and the fractional energy lost by an electron on collision with a hydrogen molecule were obtained from measurements of the microwave conductivity of a gaseous plasma. The experiments were made in the afterglow of a pulsed discharge in a cavity resonating at a wavelength of 10 cm. The mean electron energy was varied from 0.04 eV (room temperature) to 0.08 eV by heating the gas, and from 0.04 eV to 1.6 eV by microwave agitation of the electrons alone. The collision probability in molecular hydrogen at electron energies in the neighbourhood of 0.04 eV is found to be $28.5(v/v_0)^{0.55}(\text{cm-mm Hg})^{-1} \pm 3\%$, where v is the electron velocity, and v_0 the most probable velocity at 300°K. Measurements in deuterium gas gave the same result. The collision probability in hydrogen increases to a peak value of $64\ (\text{cm-mm Hg})^{-1} \pm 7\%$ at an electron energy of approximately 1.4 eV. The energy loss of electrons near room temperature was found by comparing the conductivity measurements obtained by thermal agitation with those obtained by microwave agitation of the electrons. The fraction of the excess electron energy lost on collision with the hydrogen molecule is $(3.5\pm0.5)\times10^{-3}$. In the higher energy range, the loss and the collision probability were computed from a comparison between microwave conductivity measurements and electron drift velocity and diffusion experiments.

539.12

3733. ON SOMMERFELD'S APPROXIMATION IN HIGH ENERGY PHOTOELECTRIC EFFECT AND ONE QUANTUM ANNIHILATION OF POSITRONS IN THE K-SHELL. H.Banerjee.

Nuovo Cimento, Vol. 10, No. 5, 863-80 (Dec. 1, 1958).

The angular distribution and the total cross-section for the high-energy photoelectric effect and one-quantum annihilation of positrons in the K-shell is calculated with the use of the Sommerfeld—Maue approximation for the wave-function of the scattering state of the fermion. The error in this procedure is of relative order (a/ϵ), where $a = Z/137$ and ϵ is the energy of the scattering state in units of mc^2, and is, therefore, negligible in the extreme relativistic case. Results are obtained correctly up to terms of relative order a and methods for calculating the contributions from higher terms are also indicated. The expression for the angular distribution of photoelectrons obtained does not show any marked qualitative difference from Sauter's formula. One may conclude from the author's results that the ratio of the forward to the maximum intensities of the photoelectrons diminishes as the primary energy is increased. The absorption coefficient for the photoelectric effect is presented in a form which is similar to Hall's results. Correction terms in the formulae of Bhabha and Hulme for the positron annihilation process is found to be the same as those in Sauter's formula.

539.12 : 530.145

3734. WIDE-ANGLE PAIR PRODUCTION AND QUANTUM ELECTRODYNAMICS AT SMALL DISTANCES.

J.D.Bjorken, S.D.Drell and S.C.Frautschi.

Phys. Rev., Vol. 112, No. 4, 1409-17 (Nov. 15, 1958).

Wide-angle photoproduction of high-energy electron—positron pairs in hydrogen is proposed and analysed as a test of quantum electrodynamics at distances $<\sim 10^{-13}$ cm. The effect of proton structure can be removed in terms of the two form factors measured in the elastic electron-proton scattering process. Cross-sections are presented for two classes of pair production experiments: (1) those detecting one of the final particles, and (2) coincidence experiments. In addition to kinematic, anomalous moment, and nucleon form-factor corrections to the Bethe—Heitler formula, dynamical corrections to the proton current and radiative corrections are calculated. The final theoretical formula is believed to be accurate to 2%. A simple cut-off model suggests that a 5% accuracy in an experiment of type (1) tests the electron propagator at distances $\sim 0.7 \times 10^{-13}$ cm, while a 10% accuracy in a coincidence arrangement of type (2) probes the electron propagator at $\sim 0.3 \times 10^{-13}$ cm.

539.12

3735. DETECTION OF A $\sigma\cdot$E ENERGY SHIFT IN POSITRONIUM FORMED FROM POLARIZED POSITRONS.

F.E.Obenshain and L.A.Page.

Phys. Rev., Vol. 112, No. 1, 179-82 (Oct. 1, 1958).

In an experiment designed to set an upper limit on the magnitude of $\sigma\cdot$E energy for electrons and positrons, a persistent effect is found on reversing the direction of the electric field E applied to a gas sample in which positronium is formed from polarized Na^{22} positrons. The positronium decay is studied by the two-photon angular correlation technique, and a 5% effect on the narrow-component coincidence rate is occasioned by reversing the 15 kV/cm field. The effect reverses sign when the positron spin-polarization just before capture, $P_z = \langle\sigma_z\rangle$, which is at least 0.25, is reversed by changing the source position. Other observations made concurrently suggest that the highly Stark-mixed (excited) levels of positronium in transient existence may be acting as a spin-filter whose action reverses with E. Such behaviour would entail mixing between triplet (heavily mized S and P) levels and the adjacent (similarly mixed S and P) singlet levels — to which problem quantum electrodynamics has heretofore not been applied.

539.12

3736. EVALUATION OF γ'_0 FROM THE ANGULAR DISTRIBUTION OF JET PARTICLES IN L.S. USING CERTAIN SUPPOSITIONS ABOUT THEIR ANGULAR DISTRIBUTION IN THE C.M.S.

V.Petržílka.

Nuovo Cimento, Vol. 10, No. 3, 490-5 (Nov. 1, 1958).

The angular distribution of charged particles from a high energy nuclear collision depends on the angular distribution in the centre of mass system (c.m.s.), and on the velocity β'_0 of the centre of mass system in the laboratory (l.s.). Methods are already established whereby β'_0, or, equivalently γ'_0, the nucleon energy in the c-system in units of the rest mass, can be estimated from the angular distribution in the laboratory. The author introduces a new procedure for evaluating γ'_0 using the integral angular distribution in the laboratory system, and making suitable assumptions about the distribution in the c-system. The formulae derived for three different such assumptions are used to obtain the energy of the colliding nucleons in eight jets, and the results are compared with the more usual methods.

S.J.Goldsack

539.12 : 537.591.8

3737. ON THE INTERPRETATION OF JETS BY THE EXCITED NUCLEON MODEL. J.Burmeister, K.Lanius and H.W.Meier.

Nuovo Cimento, Vol. 11, No. 1, 12-20 (Jan. 1, 1959). In German.

A method for the determination of γ_C in nucleon—nucleon collisions of very high energy based on the model of excited nucleons is presented. Isotropic angular distribution of the secondary particles in the centre of mass systems of the emitting nucleons is assumed. The energy of all secondaries is assumed to be the same in both systems. Relations for γ_c and the Lorentz factor γ' of the nucleon after the collisions in the centre of gravity frame of reference are given. The γ_c values computed for a great number of high energy jets are compared with the values following from the statistical method of Castagnoli et al. A comparison is made with the data given by Koba for the multiplicity in the two centre model. The relations recently presented by Tschernawski for the Heisenberg case of π–N collisions are in good agreement with the authors' assumptions.

539.12

3738. EMPIRICAL MODEL FOR ULTRARELATIVISTIC NUCLEON–NUCLEON COLLISIONS. G.Cocconi.

Phys. Rev., Vol. 111, No. 6, 1699-706 (Sept. 15, 1958).

The interactions of ultrarelativistic ($\geq 10^{12}$ eV) primary cosmic-ray protons with nucleons in photographic plates observed thus far show that in the majority of the cases the secondaries are emitted isotropically from two centres; this fact and the observation that the average transverse momentum of the secondaries is independent both of the energy of the primary nucleon and of the energy of the secondaries themselves suggest the following empirical model. When a nucleon–nucleon collision takes place at these energies, two "bodies" are formed, that move in opposite directions with respect to the centre of momentum of the system, together with the two original nucleons, stripped of the energy necessary to create the "bodies". Each "body" emits, in its own system of reference, about half of the total number of secondaries, each secondary having an average energy of ~ 1 BeV, independent of its nature. The inelasticity of the collision is thus determined by the number of secondaries and by the velocity of each "body" in the centre-of-momentum system of the two original nucleons. Accurate determinations of the energy, in the laboratory system, of the secondaries of these interactions could provide a sensitive test for the model, but at present there are too few measurements available.

539.12

3739. ON NON-UNIQUENESS OF NUCLEON–NUCLEON SCATTERING PHASE SHIFTS.

L.G.Zastavenko, R.M.Ryndin and Chou Kuang-Chao.

Nuclear Phys., Vol. 6, No. 5, 669-71 (May, 1958).

Exhibits transformations of phase shifts which do not alter the cross-section, and one transformation which also leaves unchanged certain polarization effects. However, the phase shifts can be fixed uniquely by measuring other quantities as well. R.J.N.Phillips

539.12 : 539.17

TIME DEPENDENT THEORY OF SCATTERING OF NUCLEONS BY NUCLEI. See Abstr. 2791

539.12 : 539.17

15-65 MeV PROTONS PRODUCED IN THE PHOTODISINTEGRATION OF Al AND Ni. See Abstr. 2819

539.12

3740. EFFECTS OF VACUUM POLARIZATION SCATTERING IN THE TREATMENT OF PROTON–PROTON SCATTERING DATA.

M.de Wit and L.Durand,III.

Phys. Rev., Vol. 111, No. 6, 1597-603 (Sept. 15, 1958).

The effects of including vacuum polarization scattering in angular momentum states with L>0 and of employing the relativistic value of the Coulomb scattering parameter η_r rather than its non-relativistic value η were considered in the analysis of low-energy p–p scattering data. It has been found that about half of the apparent mean P-wave phase shift present in published data, in the energy range 1.8 - 4.2 MeV, should be attributed to this vacuum polarization scattering. A further decrease in magnitude of the P-wave is obtained when η_r is employed, rather than η. Both the vacuum polarization scattering in states with L>0 and the employment of η_r rather than η result in a contribution to the f-function which does not vary linearly with energy. The effects of these contributions on the coefficients of a polynomial expansion of f in powers of E are ascertained with reference to p–p scattering data in the energy range 0.2 to 7.5 MeV. The object of the work is more that of investigating the possible magnitude of effects on conclusions drawn from data due to applying the various corrections than that of deriving final phase-shift values.

539.12

3741. MULTIPLE SCATTERING OF PROTONS. H.Bichsel.

Phys. Rev., Vol. 112, No. 1, 182-5 (Oct. 1, 1958).

Multiple scattering was studied experimentally for protons of energy between 0.7 and 4.8 MeV in several metals. Agreement with Molière's theory of multiple scattering is found for both the shape of the distribution function and its width within the errors of the experiment (3-5%), except possibly below 1 MeV. A Gaussian curve deviates considerably from the observed distribution at large angles, and therefore does not appear to be suitable for the description of multiple scattering.

539.12 : 539.17

SCATTERING OF 310 MeV PROTONS BY CARBON. See Abstr. 2783

539.12 : 539.17

SMALL ANGLE SCATTERING OF 970 MeV PROTONS FROM CARBON. See Abstr. 2784

539.12 : 539.1.07

SPURIOUS SCATTERING OF 6.2 GeV PROTONS IN NUCLEAR EMULSIONS. See Abstr. 3703

539.12 : 539.17

3742. POLARIZATION OF THE PROTON FROM PHOTO-DISINTEGRATION OF THE DEUTERON. M.Kawaguchi.

Phys. Rev., Vol. 111, No. 5, 1314-18 (Sept. 1, 1958).

The transverse polarization of the outgoing proton from the photodisintegration of the deuteron is calculated in the angular momentum representation, without assuming any detailed interaction among particles. General formulae for the polarization, as well as for the angular distribution, are given in terms of the Racah coefficients. If one writes the angular distribution in a form $a + b \sin^2\theta(1 + 2c \cos\theta)$, the polarization is given in terms of a, b, c and the nucleon-nucleon scattering phase shifts of the S, P, and D states under reasonable assumptions. By using experimental values of a, b, and c, and scattering phase shifts as much as available and also some theoretical estimates of the phase shifts, 20 to 30% polarization is expected for up to 40 MeV gamma rays, and 10 to 20% for 140 MeV gamma rays over a wide range of angles in the centre-of-mass system.

539.12 : 539.17

3743. EFFECT OF A COMPLEX SPIN-ORBIT COUPLING ON THE POLARIZATION OF PROTONS ELASTICALLY SCATTERED FROM NUCLEI. R.M.Sternheimer.

Phys. Rev., Vol. 112, No. 5, 1785-9 (Dec. 1, 1958).

The effect of a complex spin–orbit coupling on the polarization in elastic nucleon–nucleus scattering has been investigated for the particular case of 150 MeV protons scattered from emulsion nuclei (Ag, Br, average Z = 41). The calculations were carried out for a fixed central potential V and a fixed real part U_r of the spin–orbit coupling, and with a variable imaginary part U_i of the spin–orbit coupling. It was found that the maximum polarization P_{max} inside the first diffraction peak increases somewhat with increasing U_i (from 0.55 for $U_i = 0$ to 0.76 for U_i with maximum value $U_{i,\,max}$ = = 1.0 MeV on the surface of the nucleus). The small negative values of the polarization P in the small-angle region of Coulomb scattering ($P \sim -0.02$) and the large negative values of P in the region of the first diffraction minimum are rather insensitive to changes of U_i. Calculations have also been carried out for the polarization of 150 MeV protons scattered from carbon and lead.

539.12

3744. THE ELECTRON NEUTRINO ANGULAR CORRELATION IN THE BETA DECAY OF THE FREE NEUTRON. J.M.Robson.

Canad. J. Phys., Vol. 36, No. 11, 1450-75 (Nov., 1958).

The electron–neutrino angular correlation coefficient was measured by measuring the momentum spectrum of the electrons emitted in a restricted angular range from the direction of the recoil protons. Experiments were made for two different angular ranges and yielded a best value for the angular correlation of +0.07 with an error of ±0.12. This error includes the statistical error in the form of its standard deviation and an allowance for all known systematic errors.

539.12

3745. THEORY OF THE VELOCITY DISTRIBUTION OF NEUTRONS UNDERGOING MULTIPLE SCATTERING IN EXTENDED MEDIA SUBJECTED TO THERMAL MOTION. [Theorie der snelheidsverdelingen van veelvoudig verstrooide neutronen in uitgebreide materiele middens onderworpen aan thermische beweging].

C.C.Grosjean.

University of Ghent Dissertation (1956) 160 + vii pp. In Dutch, with summary (7 pp.) in English.

The steady state energy distribution of neutrons emitted from a mono-energetic source in a practically infinite medium at a temperature T is investigated. The probability distribution of the velocity vector of a neutron after a collision with a nucleus of mass M in a well defined state of motion is calculated. This is combined with the scattering and capture probability of the neutron by the nucleus during a time interval dt and the necessary integrations are worked out. Using a Maxwellian velocity distribution of the target nuclei, and assuming 1/v capture and scattering cross-sections, the system is solved for the velocity distribution. The theory is checked by comparison with the older exact energy distribution for multiple scattering in a medium containing fixed nuclei, i.e. T = 0. Finally, the mean square velocity and the mean energy of the neutrons, for arbitrary T, are calculated. A.J.Salmon

539.12

3746. SCATTERING OF SLOW NEUTRONS ON DEUTERONS. V.N.Efimov.

Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 137-42 (1958). In Russian.

Neutron scattering lengths on deuterons were computed by the variational method, taking account of deuteron deformation. The radial dependence of the nuclear force potential was assumed to be a Gaussian curve, the parameters of which were made to agree with the data on n—p interaction at low energies. The calculation is made only for exchange forces of the Serber type. Within the experimental errors, the scattering length values agree with the experimental values.

539.12 : 539.17

ELASTIC SCATTERING OF NEUTRONS BY DEUTERONS. See Abstr. 2828

539.12 : 539.17

INELASTIC SCATTERING OF NEUTRONS BY THORIUM. See Abstr. 2829

539.12 : 539.17

3747. SOME ASPECTS OF THE SPHERICAL HARMONICS METHOD FOR NEUTRON-TRANSPORT PROBLEMS IN CYLINDRICAL GEOMETRY. L.Trlifaj.

Czech. J. Phys., Vol. 8, No. 4, 390-5 (1958).

A solution is given of the Boltzmann differential equation for the transport of monoenergetic neutrons in a complete cylindrically symmetrical medium, which scatters neutrons isotropically. The constants of integration are then expressed by means of the terms of the spherical harmonics moments. A simpler procedure is given for obtaining the results of Davison (Abstr. 8199/1957). The procedure permits of a simple extension of the results to the case when the medium scatters neutrons anisotropically.

539.12

3748. ABOUT THE INVESTIGATION OF THE DIFFUSION OF THERMAL NEUTRONS IN WATER AND PARAFFIN WITH A PULSED SOURCE. W.H.Dio.

Nukleonik, Vol. 1, No. 1, 13-18 (April, 1958). In German.

The diffusion and absorption of thermal neutrons in water and paraffin were investigated using 50 µsec pulses of fast neutrons from a Be target. The light water was held in aluminium and steel containers, shielded with cadmium. The measurements for water were carried out at various temperatures so as to determine the temperature dependence of the diffusion length and coefficient. The results obtained were compared with those of other authors. D.H.Lord

539.12 : 539.17

3749. INVESTIGATION OF INELASTIC MODERATION OF FAST NEUTRONS. T.Springer.

Nukleonik, Vol. 1, No. 2, 41-8 (July, 1958). In German.

The mean energy $\bar{E}$ of neutron from a Ra—Be source was determined before and after they had passed through spheres of lead and bismuth of various densities. This was done by determining the thermal neutron flux distribution (about the test spheres in a water moderator) from the activity induced in gold foils placed near the test spheres. The mean number of neutron collisions $\bar{\imath}$ was determined for the various spheres by a Monte-Carlo method. The relationship between $\bar{E}$ and $\bar{\imath}$ was established and was interpreted on the basis of a simple model of moderation. D.H.Lord

539.12

3750. THE P_N METHOD TO SOLVE THE TRANSPORT EQUATION FOR NEUTRONS. H.Koppe and G.Blässer.

Nucleonik, Vol. 1, No. 2, 64-6 (July, 1958). In German.

The transport equation for the plane problem is transformed into a system of coupled differential equations by expanding the flux into a set of orthogonal functions of the hemisphere. The system can then be solved by an approximation method. The solution is proved to converge satisfactorily in a particular case. Asymptotic solutions are found to a first approximation, and some general theorems are discussed. G.Martelli

539.12 : 539.17

3751. A 140 kV NEUTRON GENERATOR. F.I.Havliček.

"J.Stefan" Inst. Rep., Vol. 2, 65-71 (May, 1955). In German.

Neutrons are produced by the interaction of deuterons with tritium nuclei, giving nearly mono-energetic neutrons of 14.5 MeV. The reaction is produced by bombarding a tritium target, consisting of tritium absorbed in zircon, with a beam of deuterons. The most favourable deuteron energy is 200 keV, but the production is reduced only 20% by using 140 keV, while the accelerator is greatly simplified. In the apparatus described the voltage is obtained direct from a transformer, and the ion beam is focused with a three-cylinder electrostatic lens. The ion-source is described in detail. A deuteron current of 100 µA produces 3×10^9 neutrons/sec. S.J.Goldsack

539.12

3752. ON THE ABSOLUTE DETERMINATION OF NEUTRON FLUX WITH INDIUM PROBES. K.Stelzer.

Nukleonik, Vol. 1, No. 1, 10-13 (April, 1958). In German.

The difficulties in using measurements of the β-activity of thin indium films to determine neutron flux, can be overcome by measuring the γ-activity of the Sn^{116} produced in the film by the β-decay of In^{116}. Some of these difficulties are: the absorption of the β-rays by the film, insufficient activity to give good counting statistics, and determining the surface density of the films. Experiments were done to examine the β-absorption coefficient, the reduction of the neutron flux by the probe and to determine the film density. D.H.Lord

539.12 : 539.1.07

DETECTION OF FAST NEUTRONS BY THE ASSOCIATED PARTICLE METHOD. See Abstr. 3708

539.12

3753. POSSIBLE CONSEQUENCES OF THE ISOBAR AND FIRE BALL MODELS. Z.Koba and S.Takagi.

Nuovo Cimento, Vol. 10, No. 5, 755-62 (Dec. 1, 1958).

Two possible consequences, characteristic of the isobar model and the fire-ball model of multiple meson production, are discussed. One is the azimuthal asymmetry of secondary particles, and the other is the apparent anomaly of the inelasticity in meson—nuclear collisions.

539.12

3754. A MODEL FOR MULTIPLE MESON PRODUCTION IN NUCLEON—NUCLEON COLLISIONS. K.Niu.

Nuovo Cimento, Vol. 10, No. 6, 994-1021 (Dec. 16, 1958).

On colliding the two nucleons are considered to form two meson "lumps" which are independent of the nucleons themselves. On this basis an empirical model of multiple meson production is discussed and the details of the collision considered in some detail. The results of the model are compared with experimental data on high-energy jets. C.J.Batty

539.12

3755. PRODUCTION SPECTRUM OF MESONS IN HIGH-ENERGY NUCLEON—NUCLEON COLLISIONS. M.W.Teucher, D.M.Haskin and M.Schein.

Phys. Rev., Vol. 111, No. 5, 1384-5 (Sept. 1, 1958).

In order to obtain a production spectrum of mesons in the centre-of-mass system, three high-energy nuclear collisions were selected which satisfy very stringent criteria for nucleon—nucleon collisions and for which the momenta of all charged particles could be measured in the laboratory system. The results show that more than one-half of the mesons have energies less than 1 BeV in the centre-of-mass system. Only a few particles emitted under very small angles in the forward and backward direction have higher energies, extending up to 10 BeV. The low-energy end of the spectrum is compared with results obtained in experiments with the Berkeley Bevatron.

539.12

3756. HELICITY OF THE ELECTRON AND POSITRON IN MUON DECAY.
P.C.Macq, K.M.Crowe and R.P.Haddock.
Phys. Rev., Vol. 112, No. 6, 2061-71 (Dec. 15, 1958).

The helicity of the electron and positron from muon decay was measured by determining the sense of circular polarization of their bremsstrahlung by the method of absorption in iron magnetized against or along the direction of motion of the particles. The positron is found to be right-handed and the electron left-handed. The results are consistent with the two-component neutrino theory, which assumes (V,A) interaction, conservation of leptons, and left-handed neutrinos.

539.12

3757. LONGITUDINAL POLARIZATION OF THE ELECTRONS FROM THE DECAY OF UNPOLARIZED POSITIVE AND NEGATIVE MUONS.
G.Culligan, S.G.F.Frank and J.R.Holt.
Proc. Phys. Soc., Vol. 73, Pt 2, 169-77 (Feb., 1959).

The polarization of electrons from the decay of unpolarized positive and negative muons was detected by the method of transmission of bremsstrahlung through magnetized iron. It is shown that the positrons have positive helicity and the negatrons negative helicity, thus providing a clear demonstration of violation of invariance under charge conjugation. It follows on the basis of the two-component neutrino theory that the neutrino associated with the decay of the pion has negative helicity and the anti-neutrino positive helicity. The agreement of this with recent results for the neutrino in β-decay lends support to this theory and confirms the law of conservation of leptons.

539.12 : 530.145

μ-MESON DECAY AND THE NON-CONSERVATION OF PARITY. See Abstr. 3111

539.12

3758. MEASUREMENT OF THE ASYMMETRY PARAMETER IN $\mu \rightarrow e$ DECAY.
G.Lynch, J.Orear and S.Rosendorff.
Phys. Rev. Letters, Vol. 1, No. 12, 471-2 (Dec. 15, 1958).

Pions from a synchrocyclotron were stopped in a stack of 600 μ photographic emulsions, with a magnetic field of 25 000 gauss parallel to the plane of the pellicles. The strong field prevents depolarization of those μ-mesons initially polarized parallel to the magnetic field. The plates were scanned for examples of $\pi^+ \rightarrow \mu^+ \rightarrow e^+$ decay in which the projected direction of both μ^+ and e^+ was within 45° of the magnetic field. Of 42 000 decays examined, 10 791 were recorded, and the asymmetry parameter observed was $a = 0.298 \pm 0.019$. The V-A theory predicts that $a = P/3$, where P is the residual polarization of the muons at the time of decay. This minor discrepancy (1.8 standard deviations) could be due to statistics, or to a small residual depolarization. The authors estimate that depolarization should be less than 3%. S.J.Goldsack

539.12 : 537.591.8

3759. ON THE SPECTRUM OF HIGH ENERGY COLLISION ELECTRONS FROM μ-MESONS UNDERGROUND.
M.Avan.
C.R. Acad. Sci. (Paris), Vol. 247, No. 19, 1584-7 (Nov. 10, 1958). In French.

The electrons were observed in nuclear emulsions exposed at depths of 100, 300 and 580 m of water equivalent. The results agree well with theory. E.J.Burge

539.12

3760. THE PRODUCTION OF IMPACT ELECTRONS IN THE PASSAGE OF ENERGETIC μ-MESONS THROUGH IRON AND LEAD.
U.Pfeiffer.
Z. Naturforsch., Vol. 12a, No. 2, 148-53 (1957). In German.

An experimental investigation of the electrons leaving the plates, leading to information on the secondary processes occurring after the production of fast electrons ($E > 0.1$ MeV) by the mesons. L.Pincherle

539.12

3761. POLARIZATION OF μ-MESONS SCATTERED BY MERCURY.
G.E.Brown, L.R.B.Elton and F.Mandl.
Proc. Phys. Soc., Vol. 72, Pt 6, 1137-41 (Dec., 1958).

The polarization is calculated for both point and extended charge distributions and found to be small. C.J.Batty

539.12

3762. CHARGE INDEPENDENCE AND THE LOW-ENERGY PARAMETERS IN PION PHYSICS.
M.J.Moravcsik.
Phys. Rev., Vol. 111, No. 6, 1657-8 (Sept. 15, 1958).

It is pointed out that the striking discrepancy among the very low-energy parameters in pion physics might be resolved by considering deviations from charge independence. An accurate set of measurements of the total cross-section for charge exchange scattering at low energies is needed to prove or disprove this contention.

539.12 : 530.145

THE MESIC COUPLING CONSTANTS FROM SCATTERING AND PHOTOPRODUCTION EXPERIMENTS. See Abstr. 3132

539.12

3763. SEARCH FOR PARTICLES OF MASS 500 m_e.
S.J.Bosgra and F.Bruin.
Nuovo Cimento, Vol. 10, No. 3, 551-2 (Nov. 1, 1958).

Emulsion exposed to the Berkeley K^+ beam was unsuccessfully scanned in the area where a particle of mass 500 m_e would stop. 31 τ^1 events were examined for evidence of anomaly in the secondary tracks, also without success. It is concluded that less than 0.1% of such particles originate in K^+ decay. R.H.W.Johnston

539.12

3764. RADIATIVE CORRECTIONS TO THE $\pi \rightarrow e + \nu$ DECAY.
H.W.Lewis.
Nuovo Cimento, Vol. 10, No. 2, 405-6 (Oct. 16, 1958).

Physical arguments are adduced against the reasoning of Gatto and Ruderman (Abstr. 6162/1958). J.C.Taylor

539.12

3765. RADIATIVE CORRECTIONS TO PION BETA DECAY.
S.M.Berman.
Phys. Rev. Letters, Vol. 1, No. 12, 468-9 (Dec. 15, 1958).

The radiative corrections to $\pi \rightarrow e + \nu$ and $\pi \rightarrow \mu + \nu$ were calculated, including all real and virtual processes of order e^2, assuming that the electromagnetic coupling to the decay vertex is, to a sufficient approximation, the minimum that is dictated by gauge invariance. In the ratio of the two decay rates, the ultraviolet cut-off cancels out, and there is a logarithmic dependence on the energy resolution. The result is that this ratio is decreased by about 14%. J.C.Taylor

539.12

3766. A GENERAL TYPE OF EXPERIMENT PROPOSED TO TEST THE CONSERVATION OF PARITY IN STRONG INTERACTIONS AT HIGH ENERGIES.
P.G.Sona.
Nuovo Cimento, Vol. 9, No. 2, 334-6 (July 16, 1958).

Typical of the experiments proposed is $\pi^- + p \rightarrow n + \pi^+ + \pi^-$, where the hydrogen is unpolarized but angular correlations among the secondaries are measured. J.C.Taylor

539.12

3767. A DISCUSSION OF SOME ANGULAR DISTRIBUTIONS IN THE REACTIONS $\pi + N \rightarrow \pi + \pi + N$, $N + N \rightarrow 2N + \pi$, $\gamma + N \rightarrow \pi + \pi + N$.
G.Morpurgo.
Nuovo Cimento, Vol. 9, No. 3, 564-7 (Aug. 1, 1958).

The author suggests experiments by which parity conservation in strong interactions from high energy events can be tested. The angular distribution of emitted particles in the above reactions provides also a test of the preference of the three emitted particles for some relative angular momentum state. For the reaction $\pi + N \rightarrow \pi + \pi + N$ the distribution is a determined shape because the incident pion is spinless. Asymmetry between the forward and backward angles of emission gives evidence for lack of parity conservation, the evidence previously obtained for this type of reaction being dismissed as inconclusive. It is expected that statistically significant information will come slowly. A.E.I. Research Laboratory

539.12

3768. TWO-PAIR DECAY AND THE SPIN OF THE NEUTRAL PION.
D.W.Joseph.
Phys. Rev., Vol. 112, No. 6, 2107-11 (Dec. 15, 1958).

The rare decay mode $\pi^0 \rightarrow$ two electron pairs is investigated as a possible means of directly measuring the π^0 spin; chief consideration is given to the case of spin 2, since the occurrence of the two-photon decay requires the spin to be 0 or ≥ 2. If the angle between the planes of the two pairs is denoted by ϕ, the distribution in ϕ is proportional to $(1 + \lambda \cos 2\phi)$. For spin 2^+, λ is calculated to be $+0.001$, while for 2^-, only the restriction $-0.19 < \lambda < 0$ is found; this is to be compared with the values for spins $0^\pm$ (previously calculated by Kroll and Wada) of ± 0.19. The rate of occurrence of events in which the two pairs share the energy quite unequally is also calculated. It is found that a small value of $|\lambda|$ for spin 2^- should be accompanied by a value of this rate and of the ratio $(\pi^0 \rightarrow 4e)/(\pi^0 \rightarrow 2\gamma)$ both considerably greater than for spins $0^\pm$, while for large $|\lambda|$ or for spin 2^+ these quantities should be close to the spin $0^\pm$ values.

539.12

3769. INTERACTION AT LOW ENERGIES OF π^+ MESONS IN PHOTOGRAPHIC PLATES. A.Minguzzi and A.Minguzzi-Ranzi.
Nuovo Cimento, Vol. 10, No. 6, 1100-8 (Dec. 16, 1958).

Interactions in the energy range 0-60 MeV was investigated. The model which assumes that pion absorption in nuclei occurs via a neutron proton pair is discussed.

539.12

3770. TOTAL CROSS SECTION OF HYDROGEN FOR 143 TO 205 MeV POSITIVE PIONS. S.J.Lindenbaum and L.C.L.Yuan.
Phys. Rev., Vol. 111, No. 5, 1380-3 (Sept. 1, 1958).

Using counter techniques, a higher-precision determination of the $\pi^+ + p$ total cross-section in the neighbourhood of the $T = J = \frac{3}{2}$ resonance was made. The energy width, statistical errors, and absolute errors were considerably reduced in an extension of the authors' previously reported work. The eight total cross-sections which were determined in the pion kinetic-energy range of 143 to 205 MeV are compared with other earlier work and their theoretical interpretation is discussed.

539.12

3771. DISPERSION RELATIONS FOR THE SCATTERING OF π-MESONS ON DEUTERONS. F.Kaschluhn.
Z. Naturforsch., Vol. 13a, No. 3, 183-94 (March, 1958). In German.

The dispersion relations for elastic forward scattering of charged and neutral π-mesons on deuterons are deduced, neglecting the electromagnetic interaction. The following differences from the problem of scattering of π-mesons by free nucleons are found: (a) the scattering amplitude is symmetric in the indices of isotopic spin of the π-mesons and the dispersion relations are identical for positive, negative and neutral mesons; (b) the whole unphysical region gives a continuous contribution, without contributions from the poles; (c) the current matrix elements of the deuteron system diverge rapidly in the whole unphysical region, so that it is necessary to carry out explicitly the analytical continuation, and Bogolyubov's method is applied; (d) there are precise polarization effects pertaining to the spin of the deuteron. Reasonable assumptions on the motion of the nucleons can be made with respect to the form of the current matrix element. The calculations are carried out in detail and a comparison with the experimental results is thus made possible.
G.Martelli

539.12

3772. DISCREPANCY BETWEEN π^-–PROTON SCATTERING AND A DISPERSION EQUATION. H.J.Schnitzer and G.Salzman.
Phys. Rev., Vol. 112, No. 5, 1802-9 (Dec. 1, 1958).

The π^-–proton scattering is reanalysed following Puppi and Stanghellini. The use of more recent data in evaluating the very sensitive principal value integral and a more detailed error analysis lead, with the same coupling constant, $f^2 = 0.08$, and the same S-wave scattering lengths, $a_1 = 0.165$ and $a_3 = -0.105$, to much less disagreement than they found. However, a residual discrepancy of the same general character remains. It is pointed out that the analysis is very sensitive to the experimental charge exchange scattering, and two alternatives to using this data are suggested. The importance of D waves, in extending the analysis to energies above 300 MeV, is demonstrated. It is shown that contributions from energies above ~ 2 BeV, and reasonable changes in f^2, a_1 and a_3, cannot contribute significantly towards resolution of the discrepancy.

539.12

3773. CHARGE INDEPENDENCE AND PION SCATTERING. A.Stanghellini.
Nuovo Cimento, Vol. 10, No. 2, 398-402 (Oct. 16, 1958).

The predictions of the charge independence hypothesis are compared directly with experimental cross-sections in the region 150 to 307 MeV, without the use of phase-shift analyses. Agreement is found to within experimental errors. An attempt is made to derive S and P phase-shifts (other than the resonant α_{33}) directly from angular distributions. Positive values are found for α_1, and also for the combinations $2\alpha_{13} + \alpha_{11}$ and $\alpha_{13} - \alpha_{11}$, but these could be zero.
G.P.McCauley

539.12

3774. PION–PROTON DISPERSION RELATIONS. L.Bertocchi and L.Lendinara.
Nuovo Cimento, Vol. 10, No. 4, 734-8 (Nov. 16, 1958).

The Puppi–Stanghellini discrepancy (cf. Abstr. 8408/1957) is re-examined in the light of new data at 41.5 MeV and 98 MeV. An improvement in the region below and around the resonance is obtained, both when the subtraction is carried out at $\omega = \mu$ and at 41.5 MeV. However some discrepancy remains between 150 and 200 MeV which cannot be removed by further manipulations, but must await more detailed experiments in this region.
G.P.McCauley

539.12 : 539.17

3775. DISPERSION RELATIONS FOR PION–DEUTERON SCATTERING. II. F.Kaschluhn.
Nuclear Phys., Vol. 9, No. 2, 347-54 (Dec. [1], 1958).

The dispersion relation for elastic spin-flip forward scattering of pions on deuterons is derived and compared with the experimental data by means of Chew's impulse approximation. Unlike the previously treated case of elastic forward scattering without spin-flip, the contribution from the non-observable region in the dispersion relation is now large and permits one to determine the pion–nucleon coupling constant. Its value is in accord with that following from the dispersion relations for pion scattering on free nucleons. The investigations indicate the possibility of treating bound states within the framework of the theory of dispersion relations; however, it is necessary to perform explicitly the analytic continuation in the relations because of divergences which appear in the matrix elements of the current in the non-observable region. For previous part, see Abstr. 1673 (1959).

539.12

3776. ALTERNATIVE METHOD FOR DETERMINING THE PION–NUCLEON FORWARD SCATTERING AMPLITUDE. H.P.Noyes.
Phys. Rev., Vol. 111, No. 3, 944-7 (Aug. 1, 1958).

Since existing experiments fail to confirm the Goldberger form (Abstr. 8408/1957) of the pion–nucleon dispersion relations, and no satisfactory theoretical or experimental explanation has been found, it is clearly desirable to increase the precision of this conclusion. It is shown that by extending the measurements of the $\pi^\pm + p$ differential elastic cross-sections down to about 15°c.m., the real parts of the forward scattering amplitudes can be measured directly with precision comparable to that obtained for the cross-sections. This method depends on the assumption of charge independence only through explicitly given $e^2/\hbar v$ corrections, and above 100 MeV is less sensitive to these corrections than the method of Puppi and Stanghellini (Abstr. 8509/1955). Comparison between the results obtained by the two methods would give a useful test for the presence of systematic error.

539.12

3777. π^-–p INTERACTIONS AT 1.85 BeV/c. R.C.Whitten and M.M.Block.
Phys. Rev., Vol. 111, No. 6, 1676-83 (Sept. 15, 1958).

Reports some diffusion cloud chamber results concerning the elastic and inelastic scattering in hydrogen of pions having a momentum in the laboratory system of 1.85 BeV/c. The elastic scattering data are consistent with diffraction by a sphere of radius 0.85 f and opacity 0.9. The forward scattering amplitude was found to be in agreement with that derived from the dispersion relations. Investigation of the inelastic scattering disclosed that there is little agreement with the predictions of the Fermi statistical model. The angular and Q value distributions of the particles emerging from inelastic interactions showed little agreement with either the statistical theory or the excited isobar model.

539.12

3778. ELECTROMAGNETIC EFFECTS IN MESON–NUCLEON SCATTERING. R.A.Sorensen.
Phys. Rev., Vol. 112, No. 5, 1813-25 (Dec. 1, 1958).

The dominant part of pion–nucleon scattering is charge independent. In view of the apparent discrepancies in the dispersion relations for meson scattering, it is desirable to investigate the effects on meson–nucleon scattering of including the electromagnetic interaction in an otherwise charge-independent theory. The calculation, which is performed in the static-nucleon, one-meson approximation of Chew and Low, is divided into two parts. In the first part, the effects of the charged-neutral meson mass difference, which is assumed to be of electromagnetic origin, are calculated. In the second part, other electromagnetic effects involving one virtual photon are calculated in the "Coulomb approximation", in which the effects of transverse photons and of graphs in which the incoming and outgoing meson lines are crossed, are ignored. A formula is given by means of which the three meson–proton differential cross-sections may be analyzed in terms of the six charge-independent s- and p-wave phase-shifts which would occur in the absence of the electromagnetic interaction. Aside from simple Coulomb and kinematic effects, the most important effect in π^+–proton scattering can be expressed as an alteration of the $J = \frac{3}{2}$ phase-shift for that state such as to sharpen the (3,3)resonance and move it to a higher energy. The meson mass difference effect and the Coulomb effect contribute about equally to produce a phase shift alteration of about 2° at its largest.

539.12 : 530.145

MASS EFFECT IN P-STATE π–p SCATTERING. See Abstr. 3122

539.12 : 530.145

CHARGED MESON–NUCLEON DISPERSION RELATIONS WITH FIXED NUCLEONS. See Abstr. 3134

539.12 : 530.145

DISPERSION RELATIONS FOR PION–PROTON SCATTERING. See Abstr. 3146

539.12

3779. PRODUCTION OF AUGER ELECTRONS BY NEGATIVE K MESONS AND π MESONS. E.B.Chesick and J.Schneps.
Phys. Rev., Vol. 112, No. 5, 1810-12 (Dec. 1, 1958).

The mesonic Auger effect has been studied for K^- mesons and π^- mesons. It is expected that the frequency of production of Auger electrons of energy greater than 15 keV should be about 50% greater for K mesons than for π mesons due to the greater mass of the K meson. 200 π-meson stars and 195 K-meson stars in nuclear emulsion have been examined for associated slow electrons of energy greater than 15 keV. For π mesons it is found that 14% of the stars have one Auger electron and 4% have two. For K mesons 25% have one, 6% have two, and 1% have three. Thus 18% of all π-meson stars and 32% of all K-meson stars have one or more associated Auger electrons. Assuming that 54% of all stars are in the heavy elements of the emulsion, it is found that 33% of π mesons and 59% of K mesons captured in silver and bromine have one or more associated Auger electrons. Hence the increase in production by K mesons over that by π mesons is about 75%.

539.12

3780. THE PRODUCTION OF CHARGED π-MESONS BY PROTON-NUCLEI COLLISIONS. Y.Kimura, Y.Yanase and M.Shimauchi.
Mem. Fac. Sci. Kyusyu Univ. B, Vol. 2, No. 1, 32-9 (March, 1956).

An estimate has been made of the cross-section of the charged mesons and the π^+/π^- ratios from the proton-nuclei collisions in the use of the surface nucleon model of the nucleus, by adopting the impulse approximation. In an estimate of the π^+/π^- ratios to be compared with the experiments, the effect of the Coulomb interaction is considered between the produced meson and the residual nucleus, and further the effect of the final nuclear interaction is studied of the two nucleons after the meson productions.

539.12

3781. PHOTOPRODUCTION OF CHARGED PIONS IN DEUTERIUM.
M.Beneventano, G.Bernardini, G.Stoppini and L.Tau.
Nuovo Cimento, Vol. 10, No. 6, 1110-42 (Dec. 16, 1958).

An experimental analysis of the process

$$\begin{tikzcd}[row sep=small] & \pi^- + p + p \\ h\nu + D \arrow[ur] \arrow[dr] & \\ & \pi^+ + n + n \end{tikzcd}$$

is presented. The $\sigma(-)/\sigma(+)$ ratio was measured in the photon energy interval (170-230) MeV and lab. angles 45°, 75°, 105°, 150°. The results are interpreted on the impulse-approximation basis with the aim of getting information on the process $h\nu + n \rightarrow \pi^- + p$.

539.12 : 530.145

3782. SEARCH FOR EVIDENCE OF PARITY NONCONSERVATION IN π^+-MESON PRODUCTION BY POLARIZED PROTONS [IN ALUMINIUM]. E.Heer, A.Roberts and J.Tinlot.
Phys. Rev., Vol. 111, No. 2, 645-6 (July 15, 1958).

Mesons of mean energy 40 MeV were produced at 92° by 209 MeV polarized protons, and the numbers of mesons emitted parallel and antiparallel to the polarization direction were compared. No significant asymmetry was found, indicating that the parity-mixing coefficient $F^2 \leq 2 \times 10^{-3}$.

539.12

3783. REMARKS ON PION PRODUCTION IN PION–NUCLEON COLLISIONS AT MODERATE ENERGIES. S.Barshay.
Phys. Rev., Vol. 111, No. 6, 1651-7 (Sept. 15, 1958).

Pion production at incident kinetic energies of from 300 MeV to about 600 MeV is discussed. A certain representation of the matrix element is stated which involves explicitly a term that is dependent upon a pion–pion scattering amplitude off the energy shell. A partial-wave decomposition of the rest of the transition operator is attempted upon the assumption that the amplitudes so introduced contain the effect of strong pion–nucleon interactions in the P wave. Certain quantities are discussed, such as the angular distribution and the polarization of the recoil nucleon, which may be determined largely by the interference between the amplitudes involving specific pion–pion and pion–nucleon effects, respectively.

539.12

3784. PHOTOMESON PRODUCTION IN INTERMEDIATE COUPLING. K.Haller.
Phys. Rev., Vol. 111, No. 6, 1736-45 (Sept. 15, 1958).

The wave-functions for the ground state of a physical nucleon and for the scattering state of a physical nucleon and a pion are used to compute photopion production cross-sections in an intermediate-coupling approximation. Since the mesons included in the physical nucleon suffice to account for an approximately correct value of the anomalous magnetic moment, no use is made in this theory of a correction term involving experimental values of the latter. The p-wav part of the photoproduction matrix element is arrived at naturally, largely from the interaction of the meson currents with the electromagnetic field. Differential cross-sections are obtained for the production of π^+ and π^0 by photons of 200, 260, 335, and 440 MeV in the laboratory system. It is also pointed out that in the intermediate coupling theory, the ambiguity in defining a gauge-invariant Hamiltonian is nontrivial. Different procedures for generalizing the meson–nucleon interaction term into a form that is gauge invariant in an extended-source theory lead to substantially different p-wave components of the photoproduction cross-sections.

539.12

3785. PHOTOPRODUCTION OF NEUTRAL PIONS FROM HYDROGEN IN THE ENERGY RANGE 700-1100 MeV.
H.H.Bingham and A.B.Clegg.
Phys. Rev., Vol. 112, No. 6, 2053-61 (Dec. 15, 1958).

Gamma-rays from the decay of neutral pions photoproduced from hydrogen by the bremsstrahlung beam of the Caltech synchrotron were studied with a thallium chloride crystal total absorption spectrometer. The energy spectrum of the decay gamma-rays produced by a range of incident photon energy is obtained by the photon difference method and this spectrum enables a separation of the gamma-rays into two groups: (i) those from the decay of neutral pions produced singly from hydrogen and (ii) those from the decay of neutral pions from multiple-production reactions. The cross-section for the single production reaction are in agreement with the recoil proton experiments at Caltech and Cornell. For the multiple-production reactions the cross-section for producing neutral pions were measured within a range of kinetic energies:

Incident photon energy	Centre-of-mass angle	π^0 kinetic energy range (c.m.)	$d\sigma/d\Omega$ (c.m.) in cm^2 $sterad^{-1}$
990 MeV	91°	175 MeV to 360 MeV	$(5.9 \pm 1.6) \times 10^{-30}$
990 MeV	118°	80 MeV to 360 MeV	$(8.1 \pm 1.9) \times 10^{-30}$
810 MeV	114°	75 MeV to 290 MeV	$(3.7 \pm 1.0) \times 10^{-30}$

It is shown that all available multiple-production data can be explained in terms of two compound states, one at about 750 MeV and the other at some higher energy. This is in agreement with an analysis of the single-photoproduction data, which is given in an appendix. These two states are, respectively, $(T = \frac{1}{2}, J = \frac{1}{2}+)$ and $(T = \frac{3}{2}, J = \frac{1}{2}+)$.

539.12

3786. THE PHOTOPRODUCTION OF CHARGED PIONS FROM DEUTERIUM. W.R.Hogg and E.H.Bellamy.
Proc. Phys. Soc., Vol. 72, Pt 5, 895-8 (Nov., 1958).

Some new measurements are reported of the ratio R of the cross-sections for the production of negative and positive pions from deuterium at 75° by a photon beam of maximum energy 235 ± 4 MeV. The results are presented together with results of other workers, and used to obtain, by extrapolation, a value at threshold $R_0 = 1.65$. The value of R_0, suitably corrected for Coulomb effects in the deuteron, can be used with other experimental data to predict a value of the Panovsky ratio. The predicted value $P = 2.4$ is much higher than the experimental values, though the latter are rather variable. The authors suggest that, although this discrepancy may reflect an error in the physical arguments involved in the prediction, the errors in all the experiments involved are so large that it is in this latter direction that the cause of the inconsistency should first be sought.

S.J.Goldsack

539.12

3787. PHOTOPRODUCTION OF SINGLE POSITIVE PIONS FROM HYDROGEN IN THE 600 TO 1000 MeV REGION.
F.P.Dixon and R.L.Walker.
Phys. Rev. Letters, Vol. 1, No. 12, 458-60 (Dec. 15, 1958).

Magnetic spectrometer measurements of pions produced at the Cal. Tech. Synchrotron have been extended to cover c.m. angles of 20° to ~ 163° for laboratory photon energies 600-1000 MeV. Discrimination against scattered particles and background protons has been improved. A qualitative change in the angular distribution observed between 800 and 1000 MeV is tentatively explained in terms of the $T = \frac{1}{2}$, $J = \frac{5}{2}$ resonance originally invoked to explain pion scattering data (Abstr. 8403/1956). R.H.W.Johnston

539.12 : 539.17

INVESTIGATION OF THE $p + p \rightarrow d + \pi^+$ REACTION IN A BEAM OF POLARIZED PROTONS. See Abstr. 2788

539.12 : 537.591.8

ENERGY SPECTRUM OF π MESONS PRODUCED BY INTERACTION OF COSMIC RADIATION WITH EMULSION NUCLEI. See Abstr. 3624

539.12

3788. SOME FEATURES OF THE ELECTRON ENERGY SPECTRUM IN THE K_{e3} DECAY PROCESS.

S.Furuichi, S.Sawada and M.Yonezawa.

Nuovo Cimento, Vol. 10, No. 3, 541-3 (Nov. 1, 1958).

The relation of this spectrum to the type of decay interaction is discussed. R.J.N.Phillips

539.12

3789. K_{e3} AND $K_{\mu 3}$ DECAY MODES. M.Sugawara.

Phys. Rev., Vol. 112, No. 6, 2128 (Dec. 15, 1958).

A viewpoint is presented in which some boson pairs are included among members which are exerting universal weak interactions on each other. The inclusion of K-meson—pion pairs leads to direct terms responsible for K_{e3} and $K_{\mu 3}$ decay modes. It is shown that these direct terms may result in too rapid decays of K_{e3} and $K_{\mu 3}$ if one assumes the universality of the weak-coupling constant, while the branching ratio of these decay modes is quite consistent with the data.

539.12 : 530.145

POSSIBLE EXPERIMENTAL TEST OF UNIVERSAL FERMI INTERACTION. See Abstr. 3123

539.12

3790. CHARGE PROPERTIES OF THE K MESON AND HYPERON DECAY INTERACTION. R.F.Sawyer.

Phys. Rev., Vol. 112, No. 6, 2135-8 (Dec. 15, 1958).

The question of the ΔT involved in strange-particle decays is discussed in terms of universal Fermi interactions. The fundamental interactions considered contain $\Delta T > \frac{1}{2}$ as suggested by both experimental and purely theoretical considerations. It is found that by assuming global symmetry in both the pion coupling and the weak coupling one may restrict the ΔT to $\frac{1}{2}$ in a class of processes involved in hyperon decay. These are the processes in which the real pion is given off externally. A symmetry may also be incorporated which forbids the decay $\Xi^- \rightarrow N + \pi$. A breakdown of this symmetry is necessary to allow Σ^- decay. Reasons are developed for this breakdown to be manifested primarily in the P-wave part of Σ and Λ decay. A consequence is that Σ^- decay should allow no parity nonconservation. The assumption of global symmetry enables one to connect Σ decay to Λ decay. Fitting the decay rates in the suggested model yields a prediction of the Λ decay rate and asymmetry in agreement with experiment. Various ways of obtaining a selection rule prohibiting the θ^+ mode of K decay are discussed. These depend on symmetries which may be incorporated into an interaction containing $\Delta T = \frac{1}{2}, \frac{3}{2}$, and $\frac{5}{2}$.

539.12

3791. PRELIMINARY RESULTS ON K+ INTERACTION AT HIGH ENERGY (200-350 MeV).

M.Grilli, L.Guerriero, M.Merlin, Z.O'Friel and G.A.Salandin.

Nuovo Cimento, Vol. 10, No. 1, 163-7 (Oct. 1, 1958).

A stack of Ilford G5 pellicles was exposed to a 200-350 MeV K^+ beam, and 60.5 metres of track length analysed. Data are given for seven K^+— interactions. Other events are analysed in terms of energy loss, angular distribution, number of prongs in stars, charge exchange and decay. The cross-section for K—H collisions was found to be (24^{+8}_{-7}) mb. The mean free path of K^+ in nuclear matter was found to be 6 fermis. The ratio of charge exchange to scattering events was 0.43 ± 0.10. The results were analysed in terms of scattering in $T = 0$ and $T = 1$ states. K^+—n collisions, production of pions and double scattering in a nucleus are considered. P.G.Murphy

539.12

3792. RELATIVE PARITY OF CHARGED AND NEUTRAL K-PARTICLES. A.Pais.

Phys.Rev., Vol. 112, No. 2, 624-41 (Oct. 15, 1958).

Neither from the experimental nor from a theoretical point of view is it obvious that the relative parity p(K) of charged and neutral K-particles is even. This paper is devoted to a study of the case of odd p(K). It is shown that in the approximation $\delta \equiv (M_\Sigma - M_\Lambda)/M_\Lambda = 0$ the π—nucleon phenomena are charge independent provided certain coupling-constant relations are satisfied. The strong Λ—neutron and Λ—proton forces are no longer equal, but if π-interaction between Λ and nucleon predominates this equality is still nearly true. Σ- and K-mass differences may occur which are not mediated by the electromagnetic field. The effects of finite δ on π—nucleon charge independence deviations are explored. Charge symmetry is also violated. These deviations appear not to be disturbing. It is shown that the possibility exists of a negative contribution of a new kind to the proton—neutron mass difference. π—baryon and K—baryon couplings alone would lead to contradictions with experiment. These can be overcome by introducing a $KK\pi$-coupling; for odd p(K) this is compatible with parity conservation. A qualitative explanation of K-exchange scattering is given which is not unsatisfactory. The consequences for elastic K-scattering are discussed. For ΣK-production in π—nucleon collisions the possibility exists of a violation of the triangle inequalities. There appears to be a good promise for understanding the forward (backward) peaking of charged (neutral) hyperons in associated production. It is pointed out that the K-pair effects due to $KK\pi$-interaction lead to further violations of charge independence. The main effect anticipated is for π—nucleon S-scattering. The influence of a lack of charge symmetry on the nucleon-charge distribution is commented on. The symmetries of the strong interactions are classified in terms of the four-dimensional real orthogonal group. Full four-invariance is broken by parity. It is conjectured that each symmetry class is characterized by one universal coupling constant. The main points of direct experimental interest are summarized.

539.12

3793. SYMMETRIES IN BARYON—K MESON INTERACTIONS.

Y.Shimamoto.

Phys. Rev. Letters, Vol. 1, No. 12. 463-5 (Dec. 15, 1958).

In the spirit of a paper by Pais (preceding abstract), a K-meson—baryon interaction is written down which does not give rise to unwanted selection rules. J.C.Taylor

539.12 : 539.14

3794. HYPERFRAGMENTS PRODUCED BY K^0 MESONS FROM K^+ CHARGE EXCHANGE.

M.Baldo-Ceolin, H.Huzita, S.Natali, U.Camerini and W.F.Fry.

Phys. Rev., Vol. 112, No. 6, 2118-21 (Dec. 15, 1958).

Stacks of C-2 emulsion were exposed to neutral K mesons. These were produced by the charge exchange, in dense material, of K^+ mesons from the Berkeley Bevatron. Hyperfragments were found in these stacks. It is concluded that the hyperfragments were produced by K_2^0 mesons in the $\overline{K}^0$ mode. These were generated by the decay of the K_1^0 component of the K^0 beam as would be expected from the Gell-Mann—Pais scheme. Other possible mechanisms of production of the hyperfragments have been considered and shown to be unimportant.

539.12

3795. ON THE SCATTERING OF 200-300 MeV K^+ MESONS.

D.Evans, F.Hassan, K.K.Nagpaul, M.Shafi, E.Helmy, J.H.Mulvey, D.J.Prowse and D.H.Stork.

Nuovo Cimento, Vol. 10, No. 1, 168-74 (Oct. 1, 1958).

The scattering with emulsion nuclei is studied. A detailed analysis of the results is presented both in terms of the optical model for complex nuclei and of the K-meson—nucleon phase-shifts. The $T = 0$ state is found to be important at these energies. C.J.Batty

539.12 : 530.145

K^-—NUCLEON SCATTERING WITH TAMM—DANKOFF APPROXIMATION. See Abstr. 3135

539.12 : 539.17

K^--ABSORPTION IN NUCLEI. See Abstr. 2836

539.12

3796. ON THE EMISSION OF K-MESONS IN THE ANNIHILATION OF ANTIPROTONS.

A.Berthelot, C.Choquet, A.Daudin, O.Goussu and F.Lévy.

C.R. Acad. Sci. (Paris), Vol. 248, No. 1, 94-7 (Jan. 5, 1959).

In French.

A stack of photographic emulsion was exposed in a 250 MeV antiproton beam. From 132 stars observed to date 6 charged mesons have been found (1 doubtful). This is in agreement with results obtained at Berkeley (Abstr. 4249/1958). A.Ashmore

539.12

3797. PHOTOPRODUCTION OF K^+ MESONS IN HYDROGEN.

P.L.Donoho and R.L.Walker.

Phys. Rev., Vol. 112, No. 3, 981-6 (Nov. 1, 1958).

K^+ mesons produced in a liquid hydrogen target bombarded by the 1100 MeV bremsstrahlung of the California Institute of Technology synchrotron were observed. It was found that the K^+ mesons are produced in association with Λ^0-hyperons, in accordance with the law of associated production of strange particles. The K^+ mesons were momentum-analysed in a magnetic spectrometer and identified by their energy loss in three scintillation counters, the very large background due to pions and protons being virtually eliminated by means of time-of-flight discrimination. The differential cross-section for the reaction $\gamma + p \to K^+ + \Lambda^0$ was measured at photon energies of 960, 1000 and 1060 MeV at various K^+ meson laboratory angles between 15 and 45°. This cross-section shows little variation with photon energy between 960 and 1060 MeV, or with centre-of-momentum angle over the range investigated.

539.12

3798. THE PRODUCTION AND NUCLEAR CAPTURE OF A K^--MESON OBSERVED IN A CLOUD CHAMBER.

Cheng Jen-Chi, Lü Min, Hsiao Chien and Wang Kan-Chang.

Scientia Sinica, Vol. 5, No. 3, 445-8 (Sept., 1956).

Amongst 30 000 photographs of a large cloud chamber containing 7 lead plates 1.2 cm thick, there were 8200 nuclear interactions and 200 events involving strange particles. Three of these gave two identified strange particles. In one such case, described at length, two charged particles were emitted one of which decayed in the gas, the other stopping in a lead plate where it gave a nuclear interaction, emitting a π-meson and Λ^0. The stopping particle is interpreted as a K^-; there is some difficulty in interpreting the decaying particle as a normal K^+ meson. S.J.Goldsack

539.12

3799. A STUDY OF 540 τ-MESON DECAYS.

S.McKenna, S.Natali, M.O'Connell, J.Tietge and N.C.Varshneya.

Nuovo Cimento, Vol. 10, No. 5, 763-74 (Dec. 1, 1958).

A homogeneous sample of 540 τ-meson decays found in emulsion stacks exposed to the Berkeley Bevatron has been studied. Most of the events were located by track scanning, and the effects of geometrical and scanning biases were minimized. The results are discussed in detail and then combined with those of a comparably large sample examined by Baldo-Ceolin et al. (Abstr. 8860/1957). The most probable spin—parity assignment is 0^- and the deviations of the positive and negative pion energy spectra from those predicted by the relativistic statistical factor, already noted by Baldo-Ceolin et al., are confirmed and estimated.

539.12

3800. AN INVESTIGATION OF ANGULAR CORRELATIONS IN THE DECAY OF CHARGED HYPERONS.

W.Alles, N.N.Biswas, M.Ceccarelli, R.Gessaroli, G.Quareni, H.Göing, K.Gottstein, W.Püschel, J.Tietge, G.T.Zorn, J.Crussard, J.Hennessy, G.Dascola and S.Mora.

Nuovo Cimento, Vol. 10, No. 1, 175-6 (Oct. 1, 1958).

Hyperons produced in K^- capture in nuclei were examined for possible asymmetries in their decay. An earlier compilation is compared with the results of the latest measurements, and it is shown that any asymmetry, if present, is likely to be smaller than indicated by the previous results. S.J.Goldsack

539.12

3801. A POSSIBLE METHOD FOR THE DETERMINATION OF THE PARITY OF STRANGE PARTICLES.

S.M.Bilenky.

Nuovo Cimento, Vol. 10, No. 6, 1049-52 (Dec. 16, 1958).

A method for the determination of the parities of K-mesons and hyperons based on the measurement of left-right asymmetry in reactions $\pi + p$, $p + K$ on a polarized proton target is proposed.

539.12 : 539.17

INELASTIC SCATTERING OF DEUTERONS ON THE Mg^{24} NUCLEUS. See Abstr. 2802

539.12 : 541.15

3802. ALPHA-PARTICLE IRRADIATION APPARATUS.

E.J.Hart and J.Terandy.

Rev. sci. Instrum., Vol. 29, No. 11, 962-5 (Nov., 1958).

An apparatus having up to four Po^{210} sources suitable for radiation chemistry studies in liquids is described. Each unit consists of a source and housing that supplies a collimated beam of α-particles, a variable speed stirrer, and an irradiation cell holder. Energy output is measured with the ferrous sulphate dosimeter.

NUCLEUS

539.14

3803. PROTON POTENTIAL ANOMALY AND NONLOCAL POTENTIALS.

A.E.S.Green and P.C.Sood.

Phys. Rev., Vol. 111, No. 4, 1147-54 (Aug. 15, 1958).

A detailed study of the variations of the difference between the proton—nuclear potential and the neutron—nuclear potential is carrie out using ground-state mass data. A previous analysis of mirror nuclei has delimited the problem and suggested that the well difference can be neither constant nor strictly Z dependent. It is found by using analytical techniques as well as calculations performed with the Oak Ridge Oracle that the potential anomaly varies with the symmetry parameter (N—Z)/A and that the proportionality constant does not change very greatly as one proceeds from a static well to a velocity-dependent well. This is somewhat surprising in view of many studies which suggest that the nuclear symmetry energy is considerably influenced by the velocity dependence of the nuclear potential. The relative insensitivity to velocity dependence or nonlocality is attributed to surface effects not taken into account in the analyses of infinite nuclear matter. A number of possible origins of the well differences are examined including (a) the failure of Koopman's theorem, (b) the breakdown of electrostatic laws, (c) the presence of Heisenberg forces, (d) the effect of the exclusion principle, and (e) the spin dependence of nuclear forces. It is concluded that the las two effects account for the bulk of the proton potential anomaly. Indeed, these last two effects suggest that the well depths used in neutron scattering and in proton scattering vary individually with the symmetry parameter, and it is suggested that experimentalists attempt to seek out these variations in careful, low-energy scattering experiments.

539.14

3804. SINGLE-NUCLEON MODEL OF THE NUCLEUS. I.

I.Úlehla.

Czech. J. Phys., Vol. 7, No. 1, 11-19 (1957). In Russian.

Deals with a single-particle model of the nucleus. It is assumed that the nucleon in the nucleus moves in a meson field formed by the other nucleons. The nucleon is considered to be a particle with spin ½, its isotopic spin not being taken into consideration. The equations of a scalar and pseudo-scalar field are chosen for the meson field and the kind of coupling which permits stationary motion of the nucleon in the given field is investigated. The equations for particles with spin ½ moving in an arbitrary external field can be derived from the Lagrange function

$$L = \hat{\psi}(\beta^j p_j - m_0 c)\,\psi - \lambda\chi\hat{\psi}Q\psi,$$

where χ represents the tensor of the zero-th to fourth order and Q the operators 1, β^j, $i\beta^j\beta^k$, $i\beta^j\beta^k\beta^l$, $\beta^j\beta^k\beta^l\beta^m$, and where λ is the constant of coupling. Pekar's theorem [Dokl. Akad. Nauk SSSR, Vol. 97, 1011 (1954)] is generalized and it is shown that a particle with spin ½ can occur in the coupled state in a scalar meson field only during scalar interaction and in a pseudo-scalar meson field only during pseudo-vector interaction. The condition of stationariness of motion for any field is generally

$$\beta^0 Q = Q\beta^0, \quad Q = Q^+.$$

It is further shown that the coupled mobile state cannot exist with a central pseudo-scalar field and that in the case of a general pseudo-scalar field the equations of motion of the second order to not contain the term corresponding to so-called spin—orbit coupling. On the other hand, scalar coupling is possible with a central scalar field and the equations of motion of the second order contain the term with spin—orbit coupling. Equations of motion of the first order for a nucleon in a centrally symmetrical scalar meson field are

$$-\frac{2\pi}{h}\left(\frac{E}{c} - m_0 c - \lambda\chi\right)R_1 + R_2' + \frac{l+2}{r}R_2 = 0, \qquad *$$

$$\frac{2\pi}{h}\left(\frac{E}{c} + m_0 c + \lambda\chi\right)R_2 + R_1' - \frac{l}{r}R_1 = 0. \qquad *$$

These equations are valid for states with $j = l + \frac{1}{2}$. Equations for states with $j = l - \frac{1}{2}$ are obtained by replacing l by $-l - 1$.

539.14

3805. COULOMB EXCHANGE ENERGY FROM SHELL-MODEL WAVE FUNCTIONS. N.V.V.J.Swamy and A.E.S.Green.
Phys. Rev., Vol. 112, No. 5, 1719-21 (Dec. 1, 1958).

The Coulomb direct and exchange energies of several light nuclei are calculated by using harmonic-oscillator wave-functions and approximate wave-functions for a realistic diffuse-boundary potential. The Z dependence of the total exchange energy is expressed in terms of a convenient parameter c. Calculations show that for very low Z this parameter is appreciably smaller than a prior estimate by Bethe and Bacher based upon the statistical model, but that it rapidly reaches their value $5(3/16\pi)^{2/3}$ for $Z > \sim 10$.

539.14

3806. INELASTIC SCATTERING FROM LIGHT NUCLEI — THE ALPHA-PARTICLE MODEL FOR Be^9. J.S.Blair and E.M.Henley.
Phys. Rev., Vol. 112, No. 6, 2029-42 (Dec. 15, 1958).

The inelastic scattering of nucleons, deuterons, and alpha particles from light nuclei is discussed in terms of direct interactions. The validity of this description, and of the approximations made here and by other authors in calculating cross-sections, are analysed in detail. Physical arguments are given for the use of a collective representation of light nuclei, in order to explain the preferential excitation of certain well-defined nuclear states by short-wavelength projectiles. As an example, the alpha-particle model is used to characterize Be^9 and the inelastic cross-sections for excitation of rotational, vibrational, and single-particle states are calculated with an impulse approximation. The model, and results computed from it, are examined and compared to experimental findings.

539.14

3807. THE DISTRIBUTION OF NUCLEONS IN HEAVY NUCLEI. C.H.von Kenshitzki and K.Wildermuth.
Z. Naturforsch., Vol. 11a, No. 9, 757-8 (1956). In German.

The results of numerical computations based on theoretical distributions derived in a previous work (Abstr. 2993/1955). The effect of spin—orbit coupling is neglected. Curves are given for Tb^{159} and Yb^{176}. G.Martelli

539.14

3808. VALIDITY OF THE SHELL MODEL AS APPROXIMATION FOR SOME LIGHT NUCLEI. R.Hüper.
Z. Naturforsch., Vol. 12a, No. 4, 295-310 (1957). In German.

It is shown in what way the energy schemes for nuclei with A = 6, 7, 13 and 14 depend on the expression for the nucleon interaction. The calculation is based on the states of the 2p-shell only. The merits of the use of the shell model are: (1) with the exception of Li^6, the distances of energy levels agree well with experimental data; and (2) the calculated magnetic moments correspond in a relatively good approximation with the known values. The following considerations speak against the use of this model: (1) the extremely strong splitting of energy terms compared with $\hbar\omega$ in the case of the oscillator potential; (2) wrong values of the calculated quadrupole moments; (3) the unsolved problem of the β-decay of C^{14}; and (4) the difficulty of obtaining the right values of energy differences, particularly for Li^6. F.Lachman

539.14 : 539.18

3809. ON SOME CORRESPONDENCES BETWEEN ENVELOPAL AND NUCLEAR STRUCTURE OF THE ATOMS. A.Corlin.
Naturwissenschaften, Vol. 44, No. 22, 580 (1957).

These show more clearly for elements lying on the zig-zag line, if mass number is plotted against neutron excess. They occur for relative abundance of isotopes, isotope pairs, onset of non-zero orbital angular momentum, and for cases of β^- decay. P.Gray

539.14

3810. BINDING ENERGY OF THE ^{16}O NUCLEUS WITH THE CLUSTER DEVELOPMENT METHOD. J.Dąbrowski.
Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 6, No. 10, 635-43 (1958).

Reports a variational calculation of the O^{16} binding energy, using the Jastrow method with a cluster expansion. Two alternative central two-body potentials are tried; they have Yukawa shape, Serber exchange and hard cores of radii 0.2 and 0.6×10^{-13} cm, and fit low-energy two-nucleon data. The results suggest that some such potential with a hard core of intermediate radius may reproduce both the binding energy and nuclear density of O^{16}. R.J.N.Phillips

539.14

3811. ON THE BINDING ENERGY OF THE FIRST ELEMENTS IN THE PERIODIC TABLE. V.Thorsen.
Naturwissenschaften, Vol. 44, No. 14, 391-2 (1957). In German.

The magnetic binding energies are calculated of a proton and a neutron, a proton and two neutrons, two protons and one neutron, and two protons and two neutrons. They are in close agreement with the known values of the mass defects for the deuteron, the triton, the light helium isotope, and the α-particle. The deuteron when considered as a combination of two ideal magnetic dipoles (a proton and a neutron) has a resulting magnetic moment of 0.85737 n.m. R.Schnurmann

539.14 : 539.166

3812. ON THE DETERMINATION OF NUCLEAR SPINS BY THE STUDY OF NEUTRON CAPTURE GAMMA RAYS. G.Trumpy.
JENER Publ., No. 13, 81 pp. (1957).

Two types of experiment, studying angular momenta of γ-rays and of energy levels connected with radiative neutron capture, were performed. Circular polarization of the γ-rays emitted from nuclei capturing polarized neutrons was studied by means of the dependence of the Compton cross-section upon the relative spin direction of the photon and the electron. Thermal neutrons polarized by transmission through magnetized iron fell on the (n,γ)-target, and the γ-rays were detected by two NaI:Tl-crystals after having passed through analysers of iron magnetized in the direction of transmission. The degree of circular polarization was found to be in accordance with theory. Measurements were performed for the most intense neutron capture γ-rays from S, Ca, Ti, Cr, Fe, Ni, Cu, Zn and W. Coincidence and angular correlation experiments were carried out using neutron capturing targets as sources. The existence of several γ-ray cascades was established. An earlier unobserved γ-ray of 0.60 ± 0.05 MeV in Cu^{64} was found. The most prominent γ-ray cascades of Cl, Cr, Ni and Cu were studied by the angular correlation method. Combined results of these experiments yielded several spin values for the nuclei studied. The theoretical aspects pertinent to those types of method are dealt with. In particular, the degree of circular polarization of γ-rays emitted from nuclei capturing polarized neutrons is calculated for various cases, including emission of mixed multipoles.

539.14 : 539.165.2

3813. NUCLEAR SPIN-ELECTRON-NEUTRINO CORRELATION IN FORBIDDEN β DECAY. A.M.Bincer.
Phys. Rev., Vol. 112, No. 1, 244-58 (Oct. 1, 1958).

The distribution function correlating the electron and neutrino momenta with the spin orientation of the parent or daughter nucleus is calculated for forbidden transitions with Coulomb effects included. Attention is focused on the β-decay interaction law form and behaviour under time reversal. The near equivalence of the V.A. and S.T.P. forms is noted and a generalized substitution law relating the V.A., S.T.P., and V.A.S.T.P. forms is derived. A number of experiments distinguishing between the V.A. and S.T.P. forms are discussed in detail. Lastly, experiments testing time-reversal invariance are discussed with special emphasis placed on those terms in the distribution function which are not due to Fierz-like interferences and are not obscured by Coulomb effects.

539.14

3814. A PSEUDOVECTOR NUCLEAR HYPERFINE INTERACTION. H.M.McConnell.
Proc. Nat. Acad. Sci. U.S.A., Vol. 44, No. 8, 766-7 (Aug., 1958).

Analysis of a simple model shows that it is not permissible to assume that electron spin and nuclear spin interact through a symmetric dyadic. There must also be a skew symmetric part, which can be written in terms of a pseudovector coupling. It tends to orient the two spins perpendicular to one another, and may produce first-order effects on h.f.s. in paramagnetic resonance spectra. J.Hawgood

539.14

3815. NUCLEAR GROUND-STATE SPINS OF THALLIUM 198 AND 201. I.Lindgren, C.M.Johansson and S.Axensten.
Phys. Rev. Letters, Vol. 1, No. 12, 473-4 (Dec. 15, 1958).

The ground state spins of Tl^{198} and Tl^{201} were measured by the atomic beam resonance method; they were found to be 2 and 1/2, respectively. The 1.8 hr isomeric state of Tl^{198} was found to have a spin of 7. The magnetic moment of Tl^{198} was found to be less than 2×10^{-3} nuclear magnetons. P.G.Murphy

539.14 : 539.17

SPIN OF TANTALUM NUCLEI. See Abstr. 2824

539.14

3816. SPIN-ORBIT INTERACTION BETWEEN NUCLEONS AND SPIN-ORBIT COUPLING IN THE NUCLEAR SHELL MODEL.

M.Moshinsky.

Rev. Mexicana Fis., Vol. 7, No. 2, 95-109 (1958). In Spanish.

A discussion of the origin of the spin-orbit interaction in nuclei. It is shown that, with the conventional form for the potential the strength of the interaction is proportional to the first moment I_1 of the potential. The experimental value of I_1 is compared with theoretical predictions and it is shown that the two particle spin-orbit potential of Signell and Marshak (Abstr. 7172/1957) gives a result of the correct order of magnitude. L.Pincherle

539.14 : 538.69 : 538.27

3817. RE-EXAMINATION OF THE PARAMAGNETIC RESONANCE OF Np^{239}.

M.Abraham, C.D.Jeffries, R.W.Kedzie and J.C.Wallmann.

Phys. Rev., Vol. 112, No. 2, 553-4 (Oct. 15, 1958).

The microwave paramagnetic resonance spectrum previously reported (Abstr. 9334/1957) for 2.3 day Np^{239} activity incorporated into a crystal of $UO_2Rb(NO_3)_3$ has been re-examined and determined to be due, not to Np^{239}, but to radiation-induced resonance centres. Experiments tentatively suggest that these resonance centres may be Pu^{239} in an unusual oxidation state. An experiment in which Np^{239} nuclei were aligned by static h.f.s. interactions (Pound and Bleaney methods) showed an anisotropy of the γ-ray pattern; this proves that the nuclear spin $I\ (Np^{239}) > \frac{1}{2}$, in contradiction to the earlier result.

539.14 : 539.2

NUCLEAR SPIN RESONANCE LINES IN CRYSTALS. See Abstr. 2926-7

539.14

3818. THE NUCLEAR MAGNETIC MOMENT OF PLUTONIUM-239.

J.Butterworth.

Phil. Mag. (Eighth Ser.), Vol. 3, 1053-4 (Sept., 1958).

The best value obtained previously for the magnetic moment of Pu^{239} by optical spectroscopy and electron paramagnetic resonance methods was 0.4 ± 0.2 nuclear magnetons. An attempt to determine the moment more accurately by means of a nuclear magnetic induction spectrometer, using a 9 gm sample of α-plutonium with a direct magnetic field of 4200 gauss and a rotating radio-frequency field of 0.5 gauss, is described. No resonance was obtained in the range 0.2 to 0.6 nuclear magnetons, which indicates that either the nuclear magnetic moment lies outside the range searched or the resonance line has been broadened out of recognition. Evidence from other workers is quoted in support of both these possibilities. It is concluded that the magnetic moment of Pu^{239} is known with little certainty and that there is little possibility of finding it by nuclear magnetic resonance methods in α-plutonium. Alternative possibilities are discussed. A.E.I. Research Laboratory

539.14

3819. SHELL MODEL AND PROPERTIES OF SOME LIGHT NUCLEI BETWEEN A = 16 AND A = 41.

F.Winterberg.

Z. Naturforsch., Vol. 12a, No. 4, 271-81 (1957). In German.

Magnetic moments, quadrupole moments and permitted β-transitions are calculated for a number of light nuclei (between A = 16 and A = 41) on the basis of a shell model, assuming in most cases the presence of a j—j coupling; the results are compared with experimental values and discussed for each nucleus. It is found that the j—j coupling yields considerably poorer results than the intermediate coupling (i.e. a coupling between j—j and L—S). F.Lachman

539.14

3820. NUCLEAR ORIENTATION EXPERIMENTS WITH Pr^{142} AND Yb^{175} NUCLEI.

J.M.Daniels, J.L.G.Lamarche and M.A.R. Le Blanc.

Canad. J. Phys., Vol. 36, No. 8, 997-1009 (Aug., 1958).

Pr^{142} was oriented as an impurity in cerium magnesium nitrate and the anisotropy of the 1.57 MeV γ-ray was measured as a function of temperature in the range $0.003^\circ K$ to $1.0^\circ K$, both in zero external field and in a field of 320 gauss parallel to the trigonal crystal axis. The results are not consistent with what has been published about the spin Hamiltonian of Pr^{+++} in this lattice. The magnetic moment of Pr^{142} is very small, and it was not possible to see any saturation of the anisotropy at low temperatures. Values for the magnetic moment of Pr^{142} were found for two different assumed decay schemes, these are 0.11 nuclear magneton for the spin assignments $2 \xrightarrow{0} 2 \xrightarrow{2} 0$, and 0.15 nuclear magnetons for the spin assignments $2 \xrightarrow{1} 2 \xrightarrow{2} 0$. Similar experiments were carried out on Yb^{175}. Measurements were made in a variety of external magnetic fields up to 700 oersted, and at temperatures as low as $0.003^\circ K$. No anisotropy was observed for the 396 keV γ-ray, nor for the 282 keV γ-ray. The most likely explanation for this result is that the lifetime of the γ-emitting state is about 10^{-10} sec. The relation between the results of this experiment and others on the same isotope (Abstr. 8784/1957) is discussed.

539.14

3821. THE NUCLEAR QUADRUPOLE MOMENT OF Mn^{55}.

R.Rottmann.

Z. Phys., Vol. 153, No. 2, 158-63 (1958). In German.

The hyperfine structure of the Mn I spectrum was investigated with a Fabry—Perot interferometer from 2800 to 5500 A. A value o $(0.3 \pm 0.1)\ 10^{-24}\ cm^2$ was found. J.M.Hough

539.14

3822. THE INTRINSIC STATES OF ODD-A NUCLEI HAVING ELLIPSOIDAL EQUILIBRIUM SHAPE.

B.R.Mottelson and S.G.Nilsson.

K. Danske Vidensk. Selsk. mat.-fys. Skr., Vol. 1, No. 8, 105 pp. (1959).

In the regions $A \sim 25$, $150 < A < 190$ and $A > 222$, it is known that the nuclear shape deviates essentially from spherical. In this paper, the odd-A nuclei in these regions are considered and a classification of the observed intrinsic excitations is attempted on the basis of an independent-particle description of the last odd nucleon. The evidence available on beta and gamma transitions, nuclear moments, and properties of the rotational spectra are discussed in terms of this classification of the states.

539.14

3823. STRENGTH FUNCTIONS FOR DEFORMED NUCLEI.

D.J.Hughes, R.L.Zimmerman and R.E.Chrien.

Phys. Rev. Letters, Vol. 1, No. 12, 461-3 (Dec. 15, 1958).

Neutron strength functions (deduced from results of neutron transmission measurements in the few keV region, using the Brookhaven fast chopper) for nuclei with A from 100 to 240 are given. The values obtained agree with those found by a direct analysis of individual levels, and also with the theoretical predictions, in particular the double peak, of the deformed nucleus model. E.J.Squires

539.14 : 539.166.83

3824. INTERNAL CONVERSION ELECTRONS FROM COULOMB EXCITATION OF Ta^{181}.

E.M.Bernstein.

Phys. Rev., Vol. 112, No. 6, 2026-8 (Dec. 15, 1958).

The conversion electron spectrum following Coulomb excitation of Ta^{181} was remeasured with greater accuracy. The results are internally consistent with the rotational model of Bohr and Mottleson and are in excellent agreement with the gamma-ray angular distribution and yield data of McGowan and Stelson.

539.14

3825. ENERGIES OF GROUND AND EXCITED NUCLEAR CONFIGURATIONS IN THE FIRST $p_{\frac{1}{2}}$ REGION.

I.Unna and I.Talmi.

Phys. Rev., Vol. 112, No. 2, 452-61 (Oct. 15, 1958).

Shell-model analysis is applied to configurations containing both $p_{1/2}$ and $s_{1/2}$ nucleons. Energy levels of excited configurations (often recognized by their parity being opposite to that of the ground state) as well as binding energies are considered. Good agreement is obtained which gives support to the jj-coupling scheme. The results obtained are used for calculating other levels. In particular, the modes of excitation of the first excited 0+ level in O^{16} and the $\frac{1}{2}$- level in F^{19} are determined.

539.14

3826. LEVELS IN Cr^{50}, Cr^{52}, Cr^{53} AND Cr^{54}.

W.C.Porter, D.M.Van Patter, M.A.Rothman and C.E.Mandeville

Phys. Rev., Vol. 112, No. 2, 468-74 (Oct. 15, 1958).

Inelastically scattered proton spectra from targets of natural chromium and targets enriched in Cr^{50}, Cr^{53}, and Cr^{54} were studied for bombarding energies in the region from 4.3 to 4.6 MeV using a double-focusing magnetic spectrometer, at angles of observation of 91.5° and 136.2°. The enriched targets were prepared by the vacuum evaporation of Cr_2O_3 from a small carbon crucible mounted n a tungsten filament onto gold-leaf backings. Surveys were taken p to at least 2.0 MeV excitation. The following level energies in eV were determined: Cr^{50}, 780 ± 3; Cr^{52}, 1432 ± 5; Cr^{53}, 562 ± 3, 006 ± 4, and 1287 ± 5; Cr^{54}, 842 ± 6. The new level in Cr^{50} occurs t the energy expected for the first 2+ state. Inelastically scattered roton groups corresponding to the known second excited states of r^{52} and Cr^{54} were not of sufficient intensity to be observed.

539.14

3827. ENERGY LEVELS OF F^{18}. D.F.Herring.
Phys. Rev., Vol. 112, No. 4, 1217-24 (Nov. 15, 1958).

The N$^{14}(\alpha,\alpha)$N^{14} differential cross-sections reported previously Abstr. 2807/1959) have been analysed using the dispersion ormalism to obtain properties of the energy levels of F^{18}. A detailed fit of the calculated cross section to the experimental data was possible for the two broad resonances in the 3 MeV (lab) region. The 3.7 MeV (lab) anomaly cannot be accounted for by a single level. For the remaining levels, a detailed fit of the calculated cross-section to the experimental data was not attempted. t was possible, however, to restrict the J values and parity of these levels by a qualitative inspection of the data.

539.14

3828. EXCITED STATES OF V^{51} AND Cr^{53}.
M.Mazari, W.W.Buechner and A.Sperduto.
Phys. Rev., Vol. 112, No. 5, 1691-3 (Dec. 1, 1958).

The region of excitation in V^{51} up to 4.12 MeV has been investigated through studies of the inelastic scattering of protons. In this region of excitation, 35 excited states were found. The low-lying excited states of Cr^{53} were investigated through the Cr^{52}(d,p)Cr^{53} and the Mn^{55}(d,α)Cr^{53} reactions. The ground-state Q values for these reactions are 5.720 ± 0.006 and 8.275 ± 0.008 MeV, respectively. The first two excited states in Cr^{53} are at 0.565 and 1.008 MeV. In these studies, the bombarding beam was provided by an electrostatic accelerator, and the reaction products were analysed with a broad-range magnetic spectrograph.

539.14

3829. LEVELS OF Cl^{33} FROM S^{32}(p,p)S^{32} AND S^{32}(p,p'γ)S^{32}.
J.W.Olness, W.Haeberli and H.W.Lewis.
Phys. Rev., Vol. 112, No. 5, 1702-16 (Dec. 1, 1958).

Differential cross-sections for the elastic scattering of protons from S^{32} were measured for the centre-of-mass scattering angles 167.8°, 141.0°, 125.5°, 92.0°, and 63.9° for laboratory proton energies between 1.5 and 4.0 MeV. The cross-sections for inelastic scattering to the 2.237 MeV level of S^{32} were also studied for incident proton energies between 2.7 and 3.8 MeV. These data were analysed in terms of the single-level approximation of the dispersion theory. The results yield the following resonance energies (MeV) and assignments of spin and parity for the levels of the compound nucleus Cl^{33}: 1.900 ($\frac{3}{2}^-$), 2.310 ($\frac{1}{2}^-$), 2.578 ($\frac{5}{2}^-$, $\frac{7}{2}^-$), 2.810* ($\frac{3}{2}^-$), 2.895 ($\frac{1}{2}^-$), 2.902* ($\frac{5}{2}^-$, $\frac{7}{2}^-$), 2.917* ($\frac{3}{2}^+$), 3.094* ($\frac{5}{2}^-$), 3.195* ($\frac{5}{2}^+$), 3.273 ($\frac{1}{2}^+$), 3.379* ($\frac{7}{2}^-$), 3.480($\frac{3}{2}^-$), 3.570 ($\frac{1}{2}^+$), and 3.716* ($\frac{5}{2}^-$). Those resonances which exhibit observable widths for inelastic scattering are designated in the above tabulation by an asterisk. The analysis of the angular dependence of the inelastic cross-sections supports the assignemnt 2$^+$ to the first excited state of S^{32}.

539.14 : 539.163

ENERGY LEVELS OF Fe^{55}. See Abstr. 2725

539.14 : 539.166

ENERGY LEVELS IN Re^{185}. See Abstr. 2753

539.14 : 539.166

LEVELS OF Be^{10} AND B^{10}. See Abstr. 2754

539.14

3830. FIVE NEW ISOMERS WITH HALF-LIVES BETWEEN 10^{-6} AND 10^{-1} SECOND. R.B.Duffield and S.H.Vegors, Jr.
Phys. Rev., Vol. 112, No. 6, 1958-71 (Dec. 15, 1958).

Isomers with half-lives greater than approximately 5 μsec were sought between the 180 c/s, 1 μsec X-ray pulses of a 22 MeV betatron. The following new activities were observed:

Isotope	Half-life (μsec)	Gamma-ray energy (keV)	Production reaction	Production threshold (MeV)
Br^{78,80}	127 ± 5	149 ± 6	(γ,n)	11.0 ± 0.3
Br^{79,81}	37 ± 3	268 ± 4	(γ,γ')	. . .
Nb^{92}	5.9 ± 0.5	88 ± 5	(γ,n)	9.1 ± 0.7
In^{114}	(42 ± 5) × 10^3	311 ± 5	(γ,n)	9.9 ± 0.2
Sn	165 ± 15	117 ± 5 163 ± 5 504 ± 6	(γ,n)	~ 11

Excitation functions and cross-sections for the production of the above isomers are also given for some cases. The properties of all the isomers investigated are summarized. Additional results include improved values for half-lives and gamma-ray energies, plus some measurements on production thresholds, excitation functions, and cross-sections for the isomers listed in a previous paper (Abstr. 3940/1956).

539.14 : 539.166.2

3831. THE ENERGY LEVELS OF ^{31}P. I. γ-RAY SPECTRA AND DECAY SCHEMES. C.Broude, L.L.Green and J.C.Willmott.
Proc. Phys. Soc., Vol. 72, Pt 6, 1097-1114 (Dec., 1958).

Gamma-ray spectra were studied at ten resonances in the reaction Si^{30}(p,γ)P^{31} and decay schemes found by analysis of the spectra and coincidence experiments.

539.14 : 539.166.2

3832. THE ENERGY LEVELS OF ^{31}P. II. ANGULAR DISTRIBUTIONS AND CORRELATIONS. C.Broude, L.L.Green and J.C.Willmott.
Proc. Phys. Soc., Vol. 72, Pt 6, 1115-21 (Dec., 1958).

Angular distributions and triple correlations were measured at the resonances in the reaction Si^{30}(p,γ)P^{31} discussed in Pt I (see preceding abstract) and spin and parity assignments made for levels in P^{31}.

539.14 : 539.166.2

3833. THE ENERGY LEVELS OF ^{31}P. III. COMPARISON WITH THE NILSSON MODEL. C.Broude, L.L.Green and J.C.Willmott.
Proc. Phys. Soc., Vol. 72, Pt 6, 1122-9 (Dec., 1958).

The spins and parities and decay properties of P^{31} determined in Pt I and II (see preceding abstracts) are compared with the predictions of the Nilsson model. It is found that the energies, spins and parities of the lower levels are well accounted for but not their decay properties.

539.14

3834. ON THE ENERGY LEVELS OF NUCLEI IN THE NEIGHBOURHOOD OF Pb^{208}. Yü Min.
Scientia Sinica, Vol. 6, No. 3, 399-412 (June, 1957).

Some low-lying levels of Pb^{210} are calculated in j—j coupling, replacing the two-body potential by the reaction matrix in the spirit of Brueckner's work; the latter is defined by the p—p phase shifts suggested by Feshbach and Lomon (Abstr. 4204/1956). Good agreement with experiment is obtained. R.J.N.Phillips

539.14

3835. THE TWO ANTIMONY ISOMERS WITH THE MASS NUMBER 128. I.Fränz, J.Rodriguez and R.Radicella.
Z. Naturforsch., Vol. 11a, No. 12, 1037-8 (1956). In German.

It is shown that the problem of allocating mass numbers to various isotopes can be resolved by examining their γ-ray spectra. By this means the existence of two antimony isomers of mass number 128 with half-lives of 10.3 min and 9.6 hr is demonstrated. The experiments are briefly described. H.C.Cole

539.14 : 539.163

3836. A NEW ANTIMONY ISOTOPE Sb^{126}.
I.Fränz, R.Radicella and J.Rodriguez.
Z. Naturforsch., Vol. 11a, No. 12, 1038 (1956). In German.

Produced by the irradiation of tellurium with deuterons or neutrons. Sb^{126} has a half-life of 18.8 min, and was identified by examination of its γ-ray spectrum (see preceding abstract). The experiments are briefly described. H.C.Cole

539.14

3837. THE ISOMERS OF Sb^{126}. I.Fränz and H.Münzel.
Z. Naturforsch., Vol. 13a, No. 1, 53-4 (Jan., 1958). In German.

The 18.8 min activity previously reported (see preceding abstract) was identified with certainty as due to Sb^{126}.

L.Pincherle

539.14

3838. RELATIVISTIC CORRECTIONS TO THE FERMI MATRIX ELEMENT. A.Altman and W.M.MacDonald.
Phys. Rev. Letters, Vol. 1, No. 12, 456-7 (Dec. 15, 1958).

Relativistic corrections to the nuclear matrix elements for positron decay of O^{14} and Cl^{34} are calculated. The effect on the ratio of the matrix elements is not enough to mask the presence of a Fierz term. P.G.Murphy

539.14

3839. THE EFFECT OF THE FINAL STATE INTERACTION ON THE DECAY OF HYPER-^{5}He. Y.C.Tang.
Nuovo Cimento, Vol. 10, No. 5, 780-8 (Dec. 1, 1958).

It is found that the strong interaction between the α-particle and the proton produced in this decay plays a significant role in determining the energy spectra and the angular distributions of the final particles. With the $\alpha-$p force taken into account as determined by the experimental phase-shifts, a simplified calculation indicates that the pion is emitted in the energy range from about 21 to 30 MeV for approximately 90% of the events, and that the proton is scattered predominantly in the backward direction in the $\alpha-$p centre of mass system. These findings are in fair agreement with Hill's analysis of recent experimental observations on the decay of hyper-He^5.

539.14

3840. HYPERFRAGMENT DECAY ENERGY AND ANGULAR DISTRIBUTION. I. J.Szymański.

Nuovo Cimento, Vol. 10, No. 5, 834-43 (Dec. 1, 1958).

Impulse approximation is applied to hyperfragment decay. π-meson energy distribution is obtained for the $_\Lambda$He^5 case, neglecting $\pi-\alpha$ interaction. Results are compared with experiment and the validity of impulse approximation is discussed.

539.14

3841. THREE BODY FORCES IN HYPERNUCLEI. G.G.Bach.

Nuovo Cimento, Vol. 11, No. 1, 73-86 (Jan. 1, 1959).

An investigation is made to ascertain the relative importance of the two-body and three-body $\Lambda-$nucleon potentials which have the same order of coupling constant. The three-body potential, which is derived using perturbation theory from a pseudoscalar interaction, is found to be weakly singular and hence, much smaller than the two-body potential. In addition, the largest terms are non-central. In the hypertriton, where correlations are large, it is found that three-body forces are repulsive for S states and may amount to 4%. Suitable D state admixture could lead to a repulsive three-body force of nearly 6%. In heavy hypernuclei, the relative importance of three-body forces is about ½% if correlations are neglected, and may be as large as 7½% if correlations are as strong as they are in the hypertriton. It is also found that by omitting the Feynman graphs with bare lines the three-body contributions are negligible.

539.14

3842. HYPERNUCLEAR BINDING ENERGIES AND THE Λ–NUCLEON INTERACTION. R.H.Dalitz and B.W.Downs.

Phys. Rev., Vol. 111, No. 3, 967-86 (Aug. 1, 1958).

A phenomenological analysis is made of the binding-energy data for light hypernuclei in terms of a two-body $\Lambda-$nucleon interaction, in which account is taken of the empirical information available on the structure of light nuclei. It is found that the observed binding energies can be interpreted in terms of a spin-dependent $\Lambda-$nucleon interaction; the agreement obtained is adequate for any force-range between 0.4×10^{-13} cm and 0.7×10^{-13} cm (for Yukawa shape) and any exchange character for this interaction. From observations on $_\Lambda$H^4 decay it is argued that the $_\Lambda$H^4, $_\Lambda$He^4 doublet has zero spin, which requires that the singlet $\Lambda-$nucleon interaction be more attractive than the triplet. The well-depth parameter for the singlet $\Lambda-$nucleon interaction has values from 0.90 to 0.85 for ranges between 0.4×10^{-13} cm and 0.7×10^{-13} cm, the triplet interaction being attractive but only one-half to one-third as strong. Spin values are assigned to the light hypernuclei, and the angular correlations which could provide a check on these values are discussed. The absorption of K$^-$ mesons in helium is discussed; it appears that the selection rules for the production of $A = 4$ hypernuclei in this reaction may be confused by the existence of an excited state $_\Lambda$H^{4*}, $_\Lambda$He^{4*}. A number of uncertainities in the phenomenological analysis of the heavier hypernuclei are pointed out; the present data do not disagree with the conclusions based on the analysis of the lighter and better-known hypernuclei with ≤5, but they add little weight to these conclusions.

539.14

3843. MESONIC DECAY OF HELIUM HYPERFRAGMENT. P.L.Jain.

Nuovo Cimento, Vol. 10, No. 3, 557-9 (Nov. 1, 1958).

An event is described in which a particle, believed to be a π-meson, creates a small star, one branch of which comes to rest and emits a 24 MeV π^--meson, a low energy proton, and a recoil. The energy and momentum balance at the decay suggest that the event is a case of the decay of a He^4 hyperfragment, and the calculated binding energy for the Λ^0 in the He^4 nucleus is 1.1 ± 0.2 MeV.

S.J.Goldsack

539.14 : 539.12

HYPERFRAGMENTS PRODUCED BY K^0 MESONS FROM K$^+$ CHARGE EXCHANGE. See Abstr. 3794

RADIOACTIVITY

539.16.08 : 539.1.07

3844. THE STANDARDIZATION OF RADIOISOTOPES BY THE BETA–GAMMA COINCIDENCE METHOD USING HIGH EFFICIENCY DETECTORS. P.J.Campion.

Internat. J. appl. Radiation and Isotopes, Vol. 4, No. 3-4, 232-48 (Jan., 1959).

The corrections pertaining to absolute disintegration rate determinations by the $4\pi\beta-\gamma$ coincidence method are discussed. It is demonstrated that, because of the high efficiency of the 4π detector, most corrections are small. In general, the largest corrections, apart from background, are those due to the accidental coincidence rate and dead time losses, expressions for which are derived. A $4\pi\beta-\gamma$ coincidence apparatus is described. An account of the performance of this instrument is given, together with the experimental verification of the accidental coincidence rate and dead time corrections. The performance suggests that accuracies of the order 0.1% are now feasible.

539.16.08

3845. DOSE FOR NONELECTRONIC EQUILIBRIUM CONDITIONS. W.C.Roesch.

Radiation Research, Vol. 9, No. 4, 399-410 (Oct., 1958).

The "exposure dose" of X and γ-rays (i.e. dose measured in terms of ionization in air) is very nearly equivalent to the kinetic energy released by the rays in unit mass (KERM). This in turn is related to the "absorbed dose" (e.g. ergs released per gm of medium) at nearby points by an "influence function". The influence function is calculated for the cases when electronic equilibrium is not achieved on account of exponential absorption and inverse square law effects. When the difference between KERM and absorbed dose is small it can be calculated accurately: for 1.2 MeV γ-rays in aluminium (parallel beam) it is shown to be 0.45%; for Compton electrons from 6 MeV X-rays it is about 2%. The relation between a free-air chamber and a cavity extrapolation chamber is also investigated.

C.B.Allsopp

539.163

3846. THE WEISSKOPF UNITS. D.H.Wilkinson.

Atomic Energy Res. Establ. (Harwell) Rep. T/R2492, 2 pp. (1958).

Weisskopf units (Abstr. 9674/1951) are the extreme single-particle units in terms of which it is customary to measure e.m. transition strengths. A nomogram is presented giving these units as radiative widths or mean lifetimes for the ten types of transition E1-5 and M1-5, and for γ-ray energies from 2 keV to 20 MeV.

539.163

3847. DISINTEGRATION OF La^{135} AND CONFIRMATORY EXPERIMENTS ON Nd^{147}.

A.C.G.Mitchell, C.B.Creager and C.W.Kocher.

Phys. Rev., Vol. 111, No. 5, 1343-8 (Sept. 1, 1958).

The disintegrations of La^{135}, Ba^{135m}, and Nd^{147} have been studied with the help of magnetic spectrometers and scintillation counters. La^{135} decays almost entirely by electron capture. The half-life has been found to be 19.8 ± 0.2 hr. Electron capture to the ground state takes place in 95-97% of all disintegrations. Gamma-rays of energies 104, 218, 265, 295, 367, 481, 588, 642, 862 keV have been found. There is a very weak positron spectrum. The internal-conversion coefficient of the line at 481 keV has been measured. The value $\alpha_K = 0.0130$ indicates an M1 transition. The line at 862 keV has $\alpha_K = 2.5 \times 10^{-3}$. The disintegration scheme is discussed. The internal-conversion coefficient of the line at 265 keV from Ba^{135m} has been found to be $\alpha_K = 3.82 \pm 0.2$. The spectrum of Nd^{147} has been reinvestigated, confirming the scheme of Hans, Saraf, and Mandeville. The internal-conversion coefficient for the line at 92 keV has been found to be 1.52 ± 0.05.

539.163

3848. NEW ISOTOPES OF Cd AND In.

N.Nussis, J.Pahissa and E.Ricci.

Z. Naturforsch., Vol. 12a, No. 6, 520 (1957). In German.

Cd^{119} with a half-life of 10 min to form In^{119}, and Cd^{121} with a 3.5 min half-life to form In^{121} (half-lives 11.5 and 32 min) are reported to be present after bombardment of SnO$_2$ with 28 MeV deuterons. The two cadmium isotopes are produced by (d,αp) reactions on Sn^{122} and Sn^{124} respectively.

J.R.Mallard

539.163.1

3849. THE MAGNETIC DIPOLE TRANSITIONS IN Xe^{129m} AND Cs^{133}.

T.Alväger, B.Johansson and W.Zuk.
Ark. Fys., Vol. 14, Paper 22, 373-82 (1958).

The half-life of the 1-forbidden magnetic dipole transition in Xe^{129m} was measured to be $0.7 \pm 0.3 \times 10^{-9}$ sec by the method of delayed coincidences and by using a multichannel time analyser. A comparison with other transitions of the same kind shows a slight deviation for Xe^{129m}. In Cs^{133} the half-life of the 80 keV M1 transition has been remeasured to $6.3 \pm 0.2 \times 10^{-9}$ sec.

539.163.1

3850. THE HALF-LIFE OF THE 8.42 keV STATE OF 169 THULIUM.

H.Beekhuis and H.de Waard.
Physica, Vol. 24, No. 9, 767-8 (Sept., 1958).

A source of Yb^{169}(31d) was prepared by vacuum evaporation of neutron irradiated Yb_2O_3 and delayed coincidences between the 308 keV γ-rays leading to the 8.42 keV level and the M and N conversion electrons de-exciting it were plotted as a function of delay time. The half life was estimated from the slope of the delayed coincidence curve as $(37 \pm 5) \times 10^{-10}$ seconds.

A.E.I. Research Laboratory

539.163.2

3851. CHARGE SPECTROMETRY FOR Xe^{133}–Cs^{133}.

A.H.Snell and F.Pleasonton.
Phys. Rev., Vol. 111, No. 5, 1338-43 (Sept. 1, 1958).

The distribution in charge of the product atoms of the radioactive decay Xe^{133}–Cs^{133} has been examined under magnetic analysis. The relative intensities are found to be as follows, expressed in percent of the decay events, and going respectively from charge 1 through charge 23: 34.1, 3.74, 2.27, 2.15, 2.99, 4.27, 6.14, 9.5, 12.3, 9.0, 6.06, 3.32, 1.76, 1.06, 0.66, 0.32, 0.13, 0.050, 0.014, 0.0075, 0.0027, 0.0013, 0.0005. In interpreting this charge spectrum, the initial part (charges 1 through 4) is attributed mainly to atoms that escape internal conversion, and the subsequent rise to a maximum at charge 9 and decrease to charge 23 is attributed to atoms that suffer internal conversion. The ratio of the intensities of the two parts of the distribution gives a total internal conversion coefficient for the K, L, and M shells of 1.4, in rough agreement with work of others. Comparison is made with the charge spectrum arising from internal conversion in Xe^{131m}–Xe^{131}, which had previously been measured in the same apparatus. From the low-charge end of the spectrum, the probabilities of electron loss as a result of the beta decay alone are derived as follows: no-electron loss, 0.8; 1-electron loss, 0.08; 2-electron loss, 0.04; 3-electron loss, 0.03. The high-charge side of the spectrum shows a shallow dip in the region of charges 12, 13 and 14, and beyond that point there is relatively more intensity in Xe^{133}–Cs^{133} than there is in Xe^{131m}–Xe^{131}. The difference in shape probably results both from the higher K/(L + M) conversion ratio of Xe^{133}–Cs^{133} as compared with Xe^{131m}–Xe^{131}, and from the fact that the beta emission in Xe^{133}–Cs^{133} introduces electron loss by shake-off. The dip at charges 12, 13, and 14 suggests an underlying structure in the total distribution, comprising subspectra associated with the individual electron shells in which the vacancy cascades originate.

539.163.2

3852. HIGH-RESOLUTION ELECTRON SPECTROSCOPIC STUDY OF THE 60-HOUR ELECTRON-CAPTURING ISOMER Re^{182}.

C.J.Gallagher, Jr and J.O.Rasmussen.
Phys. Rev., Vol. 112, No. 5, 1730-45 (Dec. 1, 1958).

A thorough study of the conversion electron spectrum from electron capture decay of the 60 hr Re^{182} isomer is reported. A very large number of transitions are observed, including most of those reported by previous investigations on the beta decay of Ta^{182} to the same daughter nucleus W^{182}. In addition many new transitions are observed. Relative intensity comparisons from the present study add weight to a Ta^{182} decay scheme published by earlier investigators. Using the Ta^{182} decay scheme as a base, it was possible to fit most of the new transitions into a plausible decay scheme involving several new levels. A tentative grouping of many of the new levels into rotational bands is proposed, mainly on the basis of relative intensitites of gamma transitions depopulating various levels.

539.163.2

3853. EFFECT OF THE γ-RADIATION OF Co^{60} ON THE EFFECTIVE PERIOD OF I^{131} IN SOURCES OF CUPROUS IODIDE.

F.Barreira and M.Laranjeira.
Rev. Fac. Cienc. Univ. Lisboa B, Vol. 4, 79-87 (1955). In Portuguese.

The presence of water produces an instability of the sources when subjected to ionizing radiations, which affects the measured life-time.

L.Pincherle

539.163.2 : 539.17

ALPHA-RAYSPECTRA OF T(t,α)n,n. See Abstr. 2805

539.164

3854. ENERGY SPECTRUM OF α PARTICLES EMITTED FROM SOURCES OF DIFFERENT THICKNESSES.

I.Chudáček.
Czech. J. Phys., Vol. 8, No. 4, 396-403 (1958).

The shape of the energy distribution of all α-particles emitted by sources of different thicknesses was investigated. The energy distribution N(E)dE can be expressed by a semi-empirical formula, which on the whole agrees with experiment. The source of α-particles was uranium oxide U_3O_8. The energy distribution was measured with Agfa K2 nuclear emulsions 200 μ thick. Altogether 3602 trajectories of α-particles in the nuclear emulsions of five plates were measured.

539.164

3855. NATURAL RADIOACTIVITY OF CERIUM 142.

W.Riezler and G.Kauw.
Z. Naturforsch, Vol. 12a, No. 8, 665-6 (1957). In German.

The half-life for the α-decay of Ce^{142} was determined by a photographic plate method. The majority of tracks observed had ranges of about 5 μ, which showed that the α-particles had an energy of 1.5 MeV. The half-life was found to be 5.1×10^{15} years.

D.H.Lord

539.164.2

3856. ALPHA DECAY OF DEFORMED EVEN–EVEN NUCLEI.

R.R.Chasman and J.O.Rasmussen.
Phys. Rev., Vol. 112, No. 2, 512-18 (Oct. 15, 1958).

Approximate analytic methods are developed for calculating the amplitudes of alpha partial waves at the surface of deformed even–even nuclei. A two-term expansion modifying the ordinary Coulomb function to account for nuclear quadrupole coupling is applied. The amplitudes of alpha partial waves at the nuclear surface are tabulated for eight choices of phase and three valves of the intrinsic nuclear quadrupole moment. A detailed comparison is made between this treatment, that of Fröman, and the numerical integration of Rasmussen and Hansen (Abstr. 613/1959) for Cm^{242}. An approximate method of calculating phase shifts induced by the nuclear quadrupole moment is developed and compared with the results of Rasmussen and Hansen for Cm^{242}.

539.165 : 539.1.07

3857. EXPERIMENTS ON NUCLIDES DECAYING BY POSITRON EMISSION AND ELECTRON CAPTURE.

J.Konijn.
University of Delft Dissertation (1958) 106 pp.

A long-lens magnetic beta-ray spectrometer is described in detail. This was used in conjunction with a γ-ray scintillation spectrometer, a gamma–gamma angular correlation spectrometer, and proportional counter to investigate the decay of Mn^{52}, Ni^{57}, Y^{86}, and the level schemes of Cr^{52}, Co^{57} and Sr^{86}, respectively. The results are interpreted theoretically. Electron capture–positron emission branching ratios are also measured for the decays of Na^{22}, Sc^{44}, V^{48}, Mn^{52}, Co^{58}, Ni^{57},Rb^{84} and interpreted.

A.E.I. Research Laboratory

539.165

3858. POLARIZATION OF β^--PARTICLES IN ^{8}Li-DECAY.

L.Keszthelyi and J.Zimányi.
Nuovo Cimento, Vol. 10, No. 5, 909-10 (Dec. 1, 1958).

It is shown that the circular polarization of the bremsstrahlung associated with Li^8 β^--decay is consistent with a V/C polarization of the electrons. Combined with the β–ν angular correlation measurement of Lauterjung et al. (Abstr. 9035/1958) this result shows the antineutrino to have its spin parallel to its momentum.

M.A.Grace

539.165

3859. BRANCHING RATIOS OF ELECTRON CAPTURE TO POSITON EMISSION.

J.Konijn, B. van Nooijen, H.L.Hagedoorn and A.H.Wapstra.
Nuclear Phys., Vol. 9, No. 2, 296-305 (Dec. [1], 1958).

Ratios of electron capture to positron emission were measured by coincidence measurements with proportional counters, scintillation spectrometers and a beta-ray spectrometer. Results for allowed transitions(Na^{22}, Sc^{44}, V^{48}, Mn^{52}, Co^{58} and Ni^{57}) agree well with theoretical values as derived from Zweifel's work (see Abstr. 9854/1957), and indicate a value of $-(0.007 \pm 0.010)$ for the Fierz term parameter. Results for $2^- \rightarrow 2^+$ first forbidden transitions are about 20% to 60% higher than values derived from Zweifel's tables for allowed transitions.

539.165

3860. MEASUREMENTS ON THE LONGITUDINAL POLARIZATION OF BETA RAYS FROM P^{32}, Y^{90}, Pr^{144}, Au^{198}, AND Bi^{210} (RaE).

J.S.Geiger, G.T.Ewan, R.L.Graham and D.R.MacKenzie.

Phys. Rev., Vol. 112, No. 5, 1684-91 (Dec. 1, 1958).

The polarization of the beta rays from five negatron emitters was studied by the method of Møller scattering in a magnetized NiFe foil. The scattered incident electron and the recoil electron from the target foil are detected in coincidence by two scintillation counters. The difference between the coincidence counting rates for the two directions of foil magnetization divided by the average rate gives a quantitative measure of the longitudinal polarization of the incident beta rays. The experimental results are as follows: P^{32}, $P = -(0.94 \pm 0.06)v/c$; Y^{90}, $P = -(0.86 \pm 0.06)v/c$; Pr^{144}, $P = = -(0.90 \pm 0.22)v/c$; Au^{198}, $P = -(0.98 \pm 0.18)\ v/c$; and for RaE, $P = -(0.69 \pm 0.10)v/c$. The first four results may indicate a polarization magnitude slightly less than full $-v/c$. The differences are, however, within the range of possible systematic errors. The result obtained with RaE is significantly lower than the average of the other four results. This indicates a departure from $-v/c$ polarization for this nuclide.

539.165

3861. POSITRON SPECTRA OF Eu^{152} AND Eu^{152m}.

D.E.Alburger, S.Ofer and M.Goldhaber.

Phys. Rev., Vol. 112, No. 6, 1998-2003 (Dec. 15, 1958).

An intermediate-image beta-ray spectrometer equipped with spiral baffles was used to investigate positrons in the decays of Eu^{152} and Eu^{152m}. Thirteen-year Eu^{152} emits a positron group to the 0.122 MeV 2+ first excited state of Sm^{152} with an end-point energy of 0.715 ± 0.010 MeV and an intensity of 1.6×10^{-4} per disintegration (log ft = 11.9) and a positron group to the 0.366 MeV 4+ second excited state with an end point of 0.47 ± 0.03 MeV and an intensity of 0.8×10^{-4} per disintegration (log ft = 11.5). 9.3 hr Eu^{152m} emits positron group to the ground state of Sm^{152} with an end-point energy of 0.895 ± 0.005 MeV and an intensity of 7×10^{-5} per disintegration (log ft = 8.65) and a positron group to the 0.122 MeV state with an intensity of 4×10^{-5} per disintegration (log ft = 8.6). The shape of the latter group has not been established. However, its end point, when the alpha shape factor is applied, gives better agreement with the 0.122 MeV energy separation from the ground-state beta ray than the end-point of the uncorrected spectrum. The result is consistent with, but not positive proof of, the assumed spin of 0− for Eu^{152m}. The β^- end-point energies of Eu^{152} and Eu^{152m} are 1.470 ± 0.010 MeV and 1.855 ± 0.010 MeV respectively. An energy separation of 0.050 ± 0.015 MeV between Eu^{152m} and Eu^{152} is derived from the various β^+ and β^- end-point measurements. No L-conversion electrons could be found in Eu^{152m} decay corresponding to a 0.05 MeV isomeric transition. An upper limit of 3×10^{-5} per disintegration was obtained for the fractional decay of Eu^{154} by positron emission.

539.165

3862. SMALL DEVIATIONS OBSERVED IN BETA SPECTRA: In^{114}, Y^{90}, AND P^{32}.

O.E.Johnson, R.G.Johnson and L.M.Langer.

Phys. Rev., Vol. 112, No. 6, 2004-9 (Dec. 15, 1958).

The beta spectra of In^{114}, Y^{90}, and P^{32} (all of which decay by pure Gamow—Teller radiations) were very carefully studied in a magnetic spectrometer. The Fermi—Kurie plots of all three spectra exhibit small deviations from linearity corresponding to an excess of low-energy electrons. All of the evidence indicates that the observed nonstatistical shapes represent the true spectra and are not the result of instrumental distortions. The Fermi—Kurie plots of these three isotopes can be linearized by a $(1 + b/W)$ correction factor (in addition to the once-forbidden, unique shape factor in the case of Y^{90}).

539.165

3863. SMALL DEVIATIONS OBSERVED IN BETA SPECTRA: Na^{22}.

J.H.Hamilton, L.M.Langer and W.G.Smith.

Phys. Rev., Vol. 112, No. 6, 2010-19 (Dec. 15, 1958).

The intense positron spectrum of Na^{22} was measured in a magnetic spectrometer. This transition proceeds from a 3+ to a 2+ level. The observed Na^{22} spectrum has a nonstatistical shape corresponding to an excess of low-energy electrons. The well-measured spectrum of Pm^{147} was reinvestigated and found to have a statistical shape. The many tests of the experimental procedures all indicate that the observed nonstatistical spectrum of Na^{22} is not the result of instrumental distortions. Theoretical refinements for finite de Broglie wavelength, screening, and possible contributions from the twice forbidden matrix elements were considered and found to be much too small to explain the deviation from the statistical shape observed in Na^{22}. The Fermi—Kurie plot of Na^{22} can be linearized by a $(1+b/W)$ correction factor. This same factor is used to linearize the Fermi-Kurie plots of In^{114}, Y^{90}, and P^{32} (in addition to the once forbidden, unique shape factor in the case of Y^{90}). In all four cases, the value of the parameter b to yield a linear F-K plot is in the range $0.2 < b < 0.4$. At present, no theoretical explanation is offered for the correction $(1 = b/W)$. It may be regarded as an empirical correction capable of explaining the observed shapes in the case of thes four Gamow—Teller transitions. A search was also made for negative electrons accompanying the normal positron decay of Na^{22}. A weak, low-energy electron distribution was observed. This distribution may be explained by the theory of "shake-off" electrons.

539.165

3864. NATURE OF THE Li^8 BETA-DECAY INTERACTION.

C.A.Barnes, W.A.Fowler, H.B.Greenstein, C.C.Lauritsen and M.E.Nordberg.

Phys. Rev. Letters, Vol. 1, No. 9, 328-30 (Nov. 1, 1958).

The energy spectrum of the alpha-particles from the break-up of $Be^8(2^+)$ following the beta decay of $Li^8(2^+)$ is influenced by the recoil of the Be^8 nucleus. In cases where the beta-particle is emitted anti-parallel to the alpha-particle, the spectrum is shifted towards higher energies. The extent of this effect is greater when the neutrino is emitted preferentially parallel to the electron (vector or tensor interaction) than in the opposite case (scalar or axial vector interaction). The measurements of the effect reported by the authors favour the latter alternative. Coupled with the results of an earlier experiment (Abstr. 611/1959) which showed that the interaction was at least 90% Gamow—Teller, this result shows that the Gamow—Teller part is largely (at least 90%) axial vector. The results also rule out the possible classifications 1^+ and 3^+ for the Li^8 nucleus.

S.J.Goldsack

539.165

3865. β-TRANSFORMATION BETWEEN THE GROUND STATES OF RaB AND RaC.

H.Daniel.

Z. Naturforsch., Vol. 11a, No. 9, 759-60 (1956). In German.

New experimental measurements show that $6.3 \pm 2\%$ of the transformations are between ground states and that the energy limit is 1.03 ± 0.06 MeV.

J.M.Hough

539.165

3866. THE DETERMINATION OF 18 AND 4.5 MIN TECHNETIUM AND A NEW SHORT-LIVED TECHNETIUM ISOTOPE (103).

J.Flegenheimer and D.Geithoff.

Z. Naturforsch., Vol. 12a, No. 4, 351 (1957). In German.

From the β-decay curve after the irradiation of Ru^{104} with fast neutrons, an isotope with a half life of 1.2 minutes has been observed which is probably Tc^{103} produced by an (n,np) reaction.

J.R.Mallard

539.165

3867. ON THE QUESTION OF THE DECAY OF Ta^{180}. II.

P.Eberhardt, P.Signer, W.Herr and E.Merz.

Z. Naturforsch., Vol. 13a, No. 11, 1004 (Nov., 1958). In German.

See Abstr. 1510 (1956). The decay constant, λ_K, for K-capture of Ta^{180} was estimated from the isotope ratio Hf^{180}/Hf^{178} in a mineral, tantalite, of known age $(2.64 \pm 0.04 \times 10^9$ yr) : $\lambda_K \leq 1.5 \times 10^{-10}\ yr^{-1}$.

A.O.Stanesby

539.165 : 539.17

Be^7 EXTREME HIGH TEMPERATURE EXPERIMENT.

See Abstr. 2772

539.165.07

3868. AUTOMATIC RECORDING BETA-SPECTROMETER.

A.Blave and F.Grard.

Rev. H.F., Vol. 4, No. 3, 43-51 (1958). In French.

A double focusing spectrometer has been adapted to permit the automatic recording of spectra. The maximum magnet current, corresponding to an energy of 3 MeV, is 500 mA. Stabilities of one part in 10^4 are achieved. The circuits used are described in detail.

E.A.Ash

539.165.08

3869. ABSOLUTE MEASUREMENT OF LOW-ENERGY β-EMITTERS HAVING LOW SPECIFIC ACTIVITY.

Y.Le Gallic and M.Thenard.

Internat. J. appl. Radiation and Isotopes, Vol. 4, No. 3-4, 249-52 (Jan., 1959). In French.

Method particularly suited to determining the activity of low energy β-emitters. The technique employs the solutions themselves without the need of preparing solid sources. The solution is placed n a thin-walled container between two window counters, or in a bowl with a thick flat bottom, in which case only one counter is used. In the former case, the threshold of detection corresponds to × 10^{-4} μc/cm^3 and the threshold of measurement (weakest measurable activity) corresponds to 10^{-3} μc/cm^3. The accuracy of the method varies from 4 to 6 for activities between 1 μc/cm^3 and × 10^{-3} μc/cm^3.

539.165.2

3870. POSSIBLE EXPERIMENTS FOR DETERMINATION OF BETA INTERACTIONS. II. M.Morita and R.S.Morita.
Phys. Rev., Vol. 111, No. 4, 1130-7 (Aug. 15, 1958).

In Part I of this series (see Abstr. 6265/1958) some possible ecoil experiments were proposed to decide the relative strength f scalar and vector interactions and that of tensor and axial vector nteractions in beta decay. The formulae in the analysis of these xperiments were given for decays involving beta–gamma cascades nd K-capture gamma–gamma cascades. Here, similar formulae re given for decays involving beta–gamma–gamma cascades, aking into account the nuclear resonance fluorescence and circular polarization of the gamma ray. The decay of Co^{60} is discussed in detail. The degree of the circular polarization of the resonant gamma ray from Ni^{60} is 2% left-handed if the beta interaction is axial vector and 23% right-handed if tensor.

539.165.2 : 539.14

NUCLEAR SPIN-ELECTRON-NEUTRINO CORRELATION IN FORBIDDEN β DECAY. See Abstr. 3813

539.166

3871. NOTE ON THE ELECTRON CAPTURE DECAY OF ^{121}Te^m.
R.K.Gupta, S.Jha and B.K.Madan.
Nuovo Cimento, Vol. 9, No. 6, 1117 (Sept. 16, 1958).

Confirmation is obtained (See Abstr. 1232/1958) that the emission of 1130 keV γ-radiation is associated with a weak (5%) electron capture branch in the decay of 154 day Te^{121}. M.A.Grace

539.166

3872. INVESTIGATION OF GAMMA RAYS FROM RADIOACTIVE ISOTOPES. A.Kløve and A.Storruste.
Arch. Math. Naturvid., Vol. 54, Paper 6, 10 pp. (1958).

The result of some measurements on gamma-rays following the decay of Zn^{65}, Sm^{153}, Tb^{160}, Ho^{166} and Tl^{204} are reported. Energies and intensities of some low intensity gamma-rays are given.

539.166 : 539.14

3873. EXCITED STATES OF ^{50}Sn$^{116}_{66}$. A.Jones and M.De Croës.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 44, No. 9, 780-6 (1958).
In French.

The conversion coefficient ratios K/L were measured for the 0.406 and 0.137 MeV γ-transitions. Coincidences between the 0.870 MeV β and the 0.406 MeV γ were investigated. New angular correlations measurements between the 0.406 MeV γ-rays and the 2.090 MeV γ-ray emitted by an aqueous solution of InCl$_3$ are in agreement with results already obtained with solid In sources.

539.166

3874. INVESTIGATION INTO THE DECAY OF RaC" (Tl^{210}).
P.Weinzierl.
S.B. Österr. Akad. Wiss. mat.-nat. Kl. Abt. II, Vol. 166, No. 6-10, 139-59 (1957). In German.

The analysis of γ radiation of RaC" sources by means of scintillation detectors and grey-wedge or single-channel recording revealed the existence of, at least, seven γ lines. The γ–γ coincidence measurements have borne out the existence of a triple cascade (2.35-0.800 and 0.298 MeV). The evaluation of intensities of all observed γ lines results in a deficit of emitted γ energy, if the β transition is assumed to be 2 MeV. F.Lachman

539.166

3875. ABSORPTION OF THE GAMMA RADIATION OF Co^{60} IN CdS. I.D.Konozenko, V.I.Ust'yanov and V.P.Kedrov.
Zh. tekh. Fiz., Vol. 28, No. 7, 1397-401 (1958). In Russian.

Presents the results of determination of the coefficient of linear absorption for compressed (powder or small monocrystals) CdS (0.184 and 0.189 cm^{-1}, respectively, for pressing at ~ 10^4 kg/cm^2), and of the coefficient of mass absorption (0.42-0.47 cm^2/g). The mean free path of the gamma quanta from Co^{60} in CdS is 5.3 cm, and the corresponding half-value thickness is 3.6 cm.

F.Lachman

539.166 : 539.14

DETERMINATION OF NUCLEAR SPINS BY THE STUDY OF NEUTRON CAPTURE GAMMA RAYS. See Abstr. 3812

539.166.08

3876. THE USE OF AN EPPV-51 ELECTRON AUTOMATIC POTENTIOMETER FOR A SCINTILLATION SPECTROGRAPH.
A.N.Silant'ev.
Zh. tekh. Fiz., Vol. 28, No. 6, 1349-57 (1958). In Russian.

A method of measuring gamma-ray spectra is described which, although not increasing the accuracy of the data obtained, removes the human element from the individual entry of the measurements and the adjustment of the apparatus to determined energy values.

W.O.Lock

539.166.2

3877. ANALYSIS OF GAMMA–GAMMA ANGULAR CORRELATIONS INVOLVING MULTIPOLE MIXTURES.
R.G.Arns and M.L.Wiedenbeck.
Phys. Rev., Vol. 111, No. 6, 1631-3 (Sept. 15, 1958).

A method is outlined which provides for rapid analysis of directional correlations involving gamma-rays of mixed multipolarity. Specific examples are given to illustrate the application to cascades in which one or both transitions involve a mixture of dipole and quadrupole radiation.

539.166.2

3878. ON THE FIRST EXCITED LEVELS OF ^{190}Os(11^d).
F.Cappellani, U.Farinelli, F.Ferrero and R.Malvano.
Physica, Vol. 24, No. 9, 765-6 (Sept., 1958).

An angular correlation experiment has been performed on the γ-ray cascade from the second excited state of Os^{190}(11 day). The observed correlation is not consistent with the suggested $4^+ \rightarrow 2^+ \rightarrow 0^+$ sequence (Abstr. 3936/1956) but is consistent with a $2^+ \rightarrow 2^+ \rightarrow 0^+$ sequence. L.L.Green

539.166.2

3879. ON THE ANGULAR CORRELATION OF THE 72 keV/136 keV-γ–γ-CASCADE IN Re^{187}. H.J.Behrend and H.Neuert.
Z. Naturforsch., Vol. 13a, No. 3, 208-11 (March, 1958). In German.

Measurements of the coefficients A_2 and A_4 of the angular correlation confirm the assumption of the spin sequence $\frac{5}{2}+$, $\frac{7}{2}+$, $\frac{3}{2}+$ for the lowest three levels of Re^{187}. The decay is shown to be by a pure E2-transition of 72 keV followed by an admixture of 1.5% E2 in the 136 keV M1-transition. S.J.Goldsack

539.166.2

3880. MEASUREMENTS OF THE ANGULAR CORRELATION OF 208 keV/113 keV γ-γ-CASCADE OF Hf^{177} IN SOLID AND LIQUID SOURCES. H.J.Behrend.
Z. Naturforsch., Vol. 13a, No. 3, 211-15 (March, 1958). In German.

The angular dependence of the anisotropy has been found to depend on the physical state of the source. Writing $W(\theta) = \Sigma A_{2k} P_{2k}(\cos\theta)$ the observed coefficients are $A_0 = 1.0000 \pm 0.0017$ and $A_2 = -0.1627 \pm 0.0032$ and $A_4 = 0.0024 \pm 0.0042$, when the source is an aqueous solution of LuCl$_3$. These values correspond to a mixture of 95.9% E2 and 4.1% M1, for the 113 keV transition and for the 208 keV radiation the results give a 1.5% admixture of E2 in an M1 transition. Finally, from the measured attenuated angular correlations, the electric field gradients responsible for the attenuation are estimated. S.J.Goldsack

539.166.2 : 539.14

GAMMA-RAY SPECTRUM AND DECAY SCHEME OF P^{31}. See Abstr. 3831-3

539.166.83

3881. CONVERSION COEFFICIENT OF THE 87 keV TRANSITION IN ^{160}Dy. M.C.Joshi, B.N.Subba Rao and B.V.Thosar.
Nuovo Cimento, Vol. 10, No. 5, 775-9 (Dec. 1, 1958).

The K-conversion coefficient of the 87 keV, E2 transition in Dy^{160} was determined from the photoelectron spectrum and the internal conversion spectrum of Tb^{160} investigated with the intermediate image β-ray spectrometer. α^K is found to be 2.0 ± 0.2 which is large compared with the theoretical value.

539.166.83

3882. THE γ-SPECTRUM OF RaD AND THE INTERNAL CONVERSION FACTOR FOR THE 46.5 keV TRANSITION IN Bi$^{210}_{83}$.
I.Y.Krause.
Z. Phys., Vol. 152, No. 5, 586-90 (1958). In German.

Measurements made with an NaI scintillation spectrometer indicate that in the decay of RaD, 46.5 keV γ-rays are emitted with a frequency of 4.05 ± 0.08% of the decays. The internal conversion coefficient for the L-shell is calculated to be $\alpha_L = 15.6 \pm 0.8$, this value being slightly in excess of the calculated value for pure M1 transitions and a nuclear radius of $1.2 \times 10^{-13} A^{1/3}$ cm. It is further shown that any other radiation in the region of 30 keV would have an intensity of less than 4×10^{-5} quanta per RaD decay. S.J.St-Lorant

539.166.83 : 539.14

INTERNAL CONVERSION ELECTRONS FROM COULOMB EXCITATION OF Ta^{181}. See Abstr. 3824

NUCLEAR REACTIONS

539.17

3883. ON THE OPTICAL MODEL FOR NUCLEAR REACTIONS.
L.Verlet and J.Gavoret.
Nuovo Cimento, Vol. 10, No. 3, 505-19 (Nov. 1, 1958).

The scattering amplitude for two nucleons in nuclear matter is calculated, using a separable potential and taking into account the exclusion principle (Abstr. 8923/1956). From this, a complex optical potential is deduced for nuclear—nucleus scattering. Comparison is made with the classical Goldberger approximation for the imaginary part of the potential. But the discussion of the effect of the exclusion principle is somewhat inconclusive, because the result is too sensitive, even at low energy, to the special form of the potential used. The last section, using the Thomas—Fermi approximation, implies that at low energy, the absorption takes place mainly at the nuclear surface. J.Lascoux

539.17

3884. MONTE CARLO CALCULATIONS OF HIGH-ENERGY NUCLEAR INTERACTIONS. I. SYSTEMATICS OF NUCLEAR EVAPORATION. I.Dostrovsky, P.Rabinowitz and R.Bivins.
Phys. Rev., Vol. 111, No. 6, 1659-76 (Sept. 15, 1958).

The process of nuclear de-excitation by evaporation is calculated by using a Monte Carlo method and fast electronic computers. The competition between the emission of neutrons, protons, deuterons, tritons, He^3, and He^4 is studied as a function of various parameters and experimental conditions. A systematic survey is presented for a range of atomic numbers, mass numbers and excitation energy of initial nuclei. The nuclides studied extend from A = 49 to A = 239 with $Z = Z_A \pm 3$. The range of excitation energies for which computations are presented extends from 100-700 MeV. Among the parameters affecting the process the importance of the temperature correction of the Coulomb barrier and the level density parameters are considered in detail. The average properties of the process such as average numbers of the various particles emitted, the average number of nucleons, of charged particles, and of charges emitted are summarized in graphical and tabular form for various combinations of the parameters used in the computation. Energy spectra of the various emitted particles are also shown.

539.17 : 530.145

3885. ON DETERMINATION OF THE MATRIX FOR THE $a + a \to b + b'$ REACTION.
S.M.Bilen'kiĭ, L.I.Lapidus, L.D.Puzikov and R.M.Ryndin.
Zh. eksper. teor. Fiz., Vol. 35, No. 4(10), 959-61 (1958). In Russian.

The conditions for determination of the matrix of the $a + a' \to b + b'$ reaction from experimental data are considered. The number of complex scalar functions defining the reaction matrix is determined using the conditions of invariance with respect to space rotations and reflections. Time-reversal invariance of the interaction leads to relations between polarization effects in the direct and inverse reactions. The number of experiments required for complete determination of the reaction matrix is indicated.

539.17

3886. MULTIPLE PRODUCTION OF PARTICLES IN COLLISIONS BETWEEN 9 GeV PROTONS AND NUCLEONS. V.S.Barashenkov, V.A.Belyakov, E.G.Bubelev, Wang Shou Feng, V.M.Maltsev, Ten Gyn and K.D.Tolstov.
Nuclear Phys., Vol. 9, No. 1, 74-82 (Nov. [3], 1958).

Some theoretical calculations pertaining to multiple production of particles in nucleon—nucleon collisions at 7-10 GeV were presented by Barashenkov et al. (Abstr. 5193/1958). Some preliminary experimental results obtained by irradiating photographic emulsions with the proton beam from the synchrocyclotron of the Joint Institute of Nuclear Research, Dubna (U.S.S.R.), were given by Bogachev et al. (Atomnaya energiya, Vol. 4, No. 3, 281-3, 1958). In the present paper the theoretical results of Abstr. 5193 (1958) are compared with the results of some new experiments. 372 stars, of which 50 were classified as proton—nucleon collisions, were recorded in NIKFI-R photographic emulsions along the tracks of ≅ 9 GeV proton accelerated in the J.I.N.R. proton synchrocyclotron. The mean number of charged particles created in these collisions was 3.6 ± 0. The angular distribution of fast charged particles is obtained. As a whole the experimental results agree with the statistical theory of multiple particle production within the limits of the experimental errors. Some discrepancy is evident in the small-angle range and may be due to the contribution of non-central impacts and to asymmetry of the angular distribution in the c.m.s.

539.17

3887. (p,α) REACTIONS INDUCED BY 23 MeV PROTONS.
C.B.Fulmer and B.L.Cohen.
Phys. Rev., Vol. 112, No. 5, 1672-8 (Dec. 1, 1958).

The (p,α) reactions induced by 23 MeV protons in targets of a wide range of atomic number were studied by observing the outgoing alpha-particles. Alpha-particle energy distributions and absolute differential cross-sections were measured at 30, 60, 90, 120, and 150°. For targets of atomic number <∼ 50, the energy spectra and angular distributions indicate that most of the alpha-particles are produced in compound nucleus reactions; however, there is evidence that the Coulomb barriers of the excited compound nuclei are somewhat lower than those of ground state nuclei. The alpha-particles from the heaviest elements and the high-energy parts of the spectra from lighter targets are strongly forward peaked and are produced by direct interaction reactions. Total (p,α) cross-sections vary from 175 mb for Al to 3.8 mb for Pt.

539.17

3888. NUCLEON—NUCLEON INTERACTIONS AND POLARIZATION OF HIGH-ENERGY PROTONS ELASTICALLY SCATTERED FROM CARBON. S.Ohnuma.
Phys. Rev., Vol. 111, No. 4, 1173-8 (Aug. 15, 1958).

The transition matrix element in momentum space derived by Riesenfeld and Watson (Abstr. 6151/1956) was used to calculate the polarization and the triple-scattering parameter β of high-energy protons elastically scattered at small angles from carbon. As the nucleon—nucleon phase shifts which represent two-body interactions, those by Signell and Marshak, by Gammel and Thaler, and by Feshbach and Lomon were considered. In evaluating nuclear as well as Coulomb scattering amplitudes, the first Born approximation has been employed with the assumption that, in carbon, the distribution of protons is equal to that of neutrons. Final results are then independent of the assumed distribution of nucleons. It has been found that, while one cannot discriminate between Signell—Marshak and Gammel—Thaler phase shifts, both of them being in semi-quantitative agreement with experimental data, Feshbach—Lomon phase shifts may be ruled out because of the wrong sign of the resulting β. Since only the first-order transition matrix element in momentum space has been used in the present work, the calculation does not depend on the optical model potential in the usual sense.

539.17 : 539.14

3889. N^{15}(p,n)O^{15} REACTION STUDY.
K.W.Jones, L.J.Lidofsky and J.L.Weil.
Phys. Rev., Vol. 112, No. 4, 1252-6 (Nov. 15, 1958).

The excitation curve for the reaction at zero degrees was measured from threshold at 3.78 to 6.38 MeV bombarding energy. Resonances corresponding to excited states in O^{16} at 16.21, ∼16.3, ∼17.0, 17.13, 17.29, ∼17.5, 17.63, 17.84, 17.97, and 18.05 MeV were observed. The 16.21 MeV state is $J^{\pi} = 1^{+}$ and the 16.3 MeV state is $J^{\pi} = 0^{-}$. The energy difference between the N^{15}(p,n)O^{15} threshold energy and the Li^7(p,n)Be^7 H_2^+ beam thick-target threshold was found to be 17.6 ± 0.5 keV. A threshold energy for N^{15}(p,n)O^{15} of 3.7808 ± 0.0011 MeV is implied if possible differences in the extrapolated end points of the Li^7(n,n)Be^7 thresholds with H^+ and H_2^+ beams are ignored.

539.17

3890. (p,pn) REACTIONS AT PROTON ENERGIES FROM 0.3 TO 3.0 BeV. S.S.Markowitz, F.S.Rowland and G.Friedlander.
Phys. Rev., Vol. 112, No. 4, 1295-302 (Nov. 15, 1958).

Cross-sections for (p,pn) reactions on N^{14}, F^{19}, Fe^{54}, Ni^{58}, Cu^{63}, Cu^{65}, Zn^{64}, Mo^{100} and Ta^{181} were measured at proton energies of 0.4 and 3.0 BeV. For F^{19}, Cu^{65}, Mo^{100}, and Ta^{181} cross-section measurements at several other energies between 0.3 and 3.0 BeV are reported also. Within 30%, all these (p,pn) cross-sections appear to be energy-independent in this range. At a given energy the cross-sections show greater variations from nucleus to nucleus than can be explained on a purely statistical picture of knock-on processes.

Among the lightest nuclei (C^{12}, N^{14}, O^{16}, Fe^{19}), these variations can be correlated with the energy of the lowest lying level of the product nucleus which is stable with respect to particle emission. Among heavier nuclei this correlation disappears, and it is suggested that shell structure effects may be responsible for the fact that the (p,pn) cross-sections of Cu^{63}, Cu^{65}, and Zn^{64} are about 45% higher than those of Fe^{54} and Ni^{58}. Apart from these individual variations which a statistical theory could not be expected to reproduce, it is found that the recent Monte Carlo calculations of intranuclear cascades by Metropolis et al. (1958) do not even predict the right magnitude and energy dependence for the cross-sections. The calculated cross-sections are too small by factors of 2 to 3 at 0.4 BeV and show a decrease with increasing energy. Possible reasons for these discrepancies are sought in details of the nuclear model used in the calculations. Various mechanisms which may contribute to (p,pn) reactions are discussed. It is concluded that deuteron emission cannot contribute significantly at the energies considered. Processes involving evaporation of one of the nucleons are likely to decrease in importance with increasing energy, whereas the contribution of meson reactions, such as ($p,pn\pi^0$), ($p,2p\pi^-$), etc., probably increases with energy. The observed energy independence of the cross-sections may result from accidental cancellation of such opposing trends.

539.17

3891. MEASUREMENTS OF THE INTERACTION OF 95 MeV PROTONS WITH He^4. W.Selove and J.M.Teem.

Phys. Rev., Vol. 112, No. 5, 1658-66 (Dec. 1, 1958).

Elastic and inelastic scattering and the (p,d) "deuteron pickup" process have been studied using a proton beam of energy about 95 MeV incident on a liquid helium target. The elastic scattering shows a nuclear—Coulomb interference dip at 9°, a slight diffraction-type minimum at about 57°, and a deep minimum, approximately 10^{-29} cm²/sterad at 135°. (All angles and cross-sections are in the centre-of-mass system). Inelastic scattering spectra were obtained at laboratory angles of 10°, 15°, and 30°. These spectra are characterized by broad peaks, roughly 10 MeV wide, centred around an energy about 6 MeV below the upper kinematical limit for inelastic scattering. Their interpretation is discussed qualitatively both in terms of quasi-elastic nucleon—nucleon scattering and in terms of strong interaction between parts of the dissociated α-particle in virtual or continuum states. A minimum was observed in the $He^4(p,d)He^3$ differential cross-section at about 29°. Analysis of the (p,d) data at 95 and 32 MeV in the "transparent nucleus" Born approximation yielded inconsistent results; presumably this inconsistency is due to the failure of the model at the lower energy due to the tightly bound structure of He^4.

539.17 : 539.14

3892. SCATTERING OF PROTONS FROM HELIUM AND LEVEL PARAMETERS IN Li^5. P.D.Miller and G.C.Phillips.

Phys. Rev., Vol. 112, No. 6, 2043-7 (Dec. 15, 1958).

The scattering of protons from helium was investigated experimentally from 2.0 to 5.5 MeV with the Rice Institute Van de Graaf accelerator and a differentially pumped, large-volume scattering chamber. Excitation curves reveal no new states in Li^5 up to an excitation energy of 6.5 MeV. A phase-shift analysis has been made of the angular distributions at laboratory bombarding energies of 3.03, 3.51, 4.02, 4.50, and 5.00 MeV. The phase shifts derived from this experiment and from experiments at other laboratories, in the energy range 1 to 18 MeV, have been interpreted in terms of the dispersion theory, and level parameters have been extracted. The nuclear radius which best fits the P-wave phase shifts is 2.6×10^{-13} cm. For the ground state, $(E_{res})_{lab} = 2.6$ MeV, $J = \frac{3}{2}^-$, $\gamma_p{}^2 = 12 \times 10^{-13}$ MeV cm, and $\theta_p{}^2 = 0.40$. For the first excited state, $(E_{res})_{lab} = 10.8$ MeV, $J = \frac{1}{2}^-$, $\gamma_p{}^2 = 30 \times 10^{-13}$ MeV cm, and $\theta_p{}^2 = 1.0$. The S-wave phase shift is moderately well fitted by a hard-sphere interaction with a radius of 2.0×10^{-13} cm. At the present time, the D-wave phase shifts are so inaccurately known that very little interpretation is possible.

539.17

3893. STUDY OF THE DISINTEGRATION PRODUCED BY HIGH ENERGY PROTONS IN HEAVY AND LIGHT NUCLEI. S.Barkan.

Rev. Fac. Sci. Univ. Istanbul C, Vol. 22, No. 3, 280-5 (July, 1957).

Two-hundred and forty-seven disintegrations produced by 140 MeV protons have been observed in an Ilford G5 emulsion. It is reported that more α-particles are observed to be emitted from light nuclei than heavy and that also the number of fast protons per star is different for heavy and light nuclei. L.L.Green

539.17

3894. $Li^7(p,\gamma)$ ANGULAR DISTRIBUTION FOR THE 441 keV RESONANCE AND SPIN—ORBIT COUPLING IN Be^8.

H.Neuert and T.Retz-Schmidt.

Z. Naturforsch., Vol. 13a, No. 10, 829-32 (Oct., 1958). In German.

Measurements give a positive $\cos^2\theta$ anisotropy of several per cent. Study of the 17.6 MeV γ-ray indicates that the resulting Be^8 can only be described in intermediate coupling. G.E.Brown

539.17

3895. (p,γ) ANGULAR DISTRIBUTION MEASUREMENTS FOR $F^{19}(p,\alpha\gamma)O^{16}$ AT 340, 598 AND 669 keV. T.Retz-Schmidt.

Z. Naturforsch., Vol. 13a, No. 10, 833-8 (Oct., 1958). In German.

Measurements for protons accelerated to these energies by a Van de Graaff give $I\gamma(669) \sim$ isotropic, $I\gamma(598) \sim 1 + 0.17\cos^2\theta$, $I\gamma(340) \sim 1 - 0.035\cos^2\theta$ for the angular distributions of the 6.14 MeV γ-ray. The result at 340 keV can be explained by assuming that, in addition to s-protons, a small admixture of d-protons participate in the process. G.E.Brown

539.17 : 539.12

EFFECT OF A COMPLEX SPIN-ORBIT COUPLING ON THE POLARIZATION OF PROTONS ELASTICALLY SCATTERED FROM NUCLEI. See Abstr. 3743

539.17

3896. GAMMA-RAY THRESHOLD METHOD AND THE $O^{18}(d,n\gamma)F^{19}$ REACTION. J.W.Butler and H.D.Holmgren.

Phys. Rev., Vol. 112, No. 2, 461-7 (Oct. 15, 1958).

A neutron threshold technique involving observations of the gamma rays from the de-excitation of the residual excited states is described. A study of the $O^{18}(d,n\gamma)F^{19}$ reaction with this technique has resulted in the observation of neutron thresholds at bombarding energies of 346 ± 8, 525 ± 8 and 584 ± 10 keV. These thresholds correspond to states at 6.048 ± 0.014, 6.210 ± 0.014 and 6.262 ± 0.015 MeV in the F^{19} nucleus, respectively. A detailed gamma-ray spectrum was obtained at a bombarding energy of 1.00 MeV using a single-crystal spectrometer, and another detailed spectrum was obtained at 1.40 MeV using a three-crystal pair spectrometer. Coincidence measurements were made for several of the cascade gamma rays.

539.17

3897. BORON PLUS DEUTERON REACTIONS.

R.W.Kavanagh and C.A.Barnes.

Phys. Rev., Vol. 112, No. 2, 503-11 (Oct. 15, 1958).

Gamma and alpha emission from the 15 MeV level of C^{12} was investigated in the reaction $B^{11}(d,n)C^{12*}$. An upper limit on the ratio of α- to γ-radiation from the state is $\Gamma_\alpha/\Gamma_\gamma < 1.5$. The excitation threshold for 15 MeV gamma-radiation is 1.633 ± 0.003 MeV and the cross-section is given as a function of bombarding energy up to 3.25 MeV. Resonances are found at 2.180 ± 0.010 and 3.080 ± 0.015 MeV. Momentum analyses of α-particles from deuteron bombardment of B^{10} and natural boron reveal no excited states in Be^8 in the range of excitation 9.8 to 14.8 MeV, and no new states in Be^9 below 4.7 MeV excitation. The nature of the 1.75 MeV level of Be^9 is discussed. The branching of the β-decay of B^{12} to the 4.43 MeV state of C^{12} is found to be 1.4 ± 0.4%, allowing the unique assignment $J = 1^+$ to the B^{12} ground state, which is presumed to be the analogue of the 15 MeV state of C^{12}. Upper limits of (0.00 ± 0.01) and (0.1 ± 0.1)%, respectively, are found for γ-rays with $E_\gamma > 6$ MeV and $E_\gamma = 3.2$ MeV following B^{12} decay. The cross-section for the production of B^{12} is given as a function of bombarding energy for $0.5 \leq E_d \leq 3.25$ MeV.

539.17

3898. PROTON ANGULAR DISTRIBUTIONS FROM $Zn^{64,66,67,68}$ (d,p) REACTIONS. F.B.Shull and A.J.Elwyn.

Phys. Rev., Vol. 112, No. 5, 1667-72 (Dec. 1, 1958).

Angular distributions and Q values were determined for proton groups from (d,p) reactions with isotopically enriched targets of Zn^{64}, Zn^{66}, Zn^{67}, and Zn^{68}. The incident deuteron energy was 10 MeV. The angular distributions were fitted by Butler curves, from which values of l_n were determined, where $l_n h$ is the orbital angular momentum of the captured neutron. The fits were only fair, presumably because the Butler theory cannot be expected to give good fits at Z = 30 without modification. In addition, several peaks are evidently superpositions of closely spaced, unresolved groups with different l_n. Well-resolved empirical distributions which appear to correspond to l_n = 0, 1, 2, 3, and 4 were observed; these serve to indicate in which direction the Butler curves should be shifted, thus increasing confidence in the correctness of the values of l_n which were assigned. For Zn^{64}(d,p) the results are Q = 5.71 MeV with l_n = 1 and 3, Q = 4.89 MeV with l_n = 1 and 3 or 4, Q = 4.43 MeV with l_n = 2, Q = 3.86 MeV with l_n = 0, and Q = 3.31 MeV with l_n = perhaps 2 and 4. For Zn^{66}(d,p) the results are Q = 4.76 MeV with l_n = 1 and 3, Q = 4.38 MeV with l_n = 1 and 3 or 4, Q = 3.85 MeV with l_n = 2, and Q = 3.15 MeV with l_n uncertain. For Zn^{67}(d,p) the results are Q = 8.01 MeV with l_n = 3, Q = 6.90 MeV with l_n = 1, Q = 6.13 MeV with l_n unknown, and Q = 4.52 MeV with l_n = perhaps 1 and 3. For Zn^{68}(d,p) the results are Q = 4.22 MeV with l_n = 1, Q = 3.78 MeV with l_n = 4, and Q = 3.40 with l_n = 2.

539.17

3899. N^{14}(d,n)O^{15} AND N^{15}(d,n)O^{16} REACTIONS.

J.L.Weil and K.W.Jones.

Phys. Rev., Vol. 112, No. 6, 1975-81 (Dec. 15, 1958).

Absolute cross-sections for these reactions were measured at zero degrees to the incident deuteron beam from 0.6 to 5.2 MeV bombarding energy. Both excitation curves show strong resonance structure and have maximum cross-sections of about 6 milibarns per steradian. Eight angular distributions were measured for the N^{15}(d,n)O^{16} reaction at points on and off maxima in the excitation curve. A good fit to the angular distributions is obtained by use of the exchange stripping theory of Owen and Madansky.

539.17

3900. ANGULAR DISTRIBUTIONS FROM DEUTERON BOMBARDMENT OF BERYLLIUM AND BORON.

B.Zeidman and J.M.Fowler.

Phys. Rev., Vol. 112, No. 6, 2020-6 (Dec. 15, 1958).

The angular distributions, from 10° to 160°, of the emergent particles from the reactions Be^{9}(d,p)Be^{10,10*}, B^{10}(d,p)B^{11,11*}, and B^{11}(d,n)C^{12,12*} were investigated. The proton distributions were obtained at incident deuterion energies of 10, 9.2, and 8.1 MeV while the neutron distributions were obtained with 10 MeV deuterons. The proton distributions are analysed using the Butler theory of deuteron stripping and, with the exception of the distributions from B^{11*}, are in agreement with l_n = 1 at forward angles. The distributions from the first excited state of B^{11} are not in agreement with any curves based upon the Butler theory, indicating that stripping does not play a major part in this reaction. The neutron distributions are analysed using the treatment of Owen and Madansky, which allows heavy-particle stripping as well as Butler stripping. Reasonable agreement between the data and this theory for the ground state is obtained by using approximately equal amplitudes for Butler and exchange stripping and angular momenta of l = 1 and l = 0, respectively, for deuteron and exchange stripping. The analysis of the distribution for the first excited state of C^{12} shows l = 1 for deuteron stripping, but does not provide a unique choice for the angular momentum in exchange stripping.

539.17 : 539.14

3901. SCATTERING OF He^{3} FROM He^{4} AND STATES IN Be^{7}.

P.D.Miller and G.C.Phillips.

Phys. Rev., Vol. 112, No. 6, 2048-52 (Dec. 15, 1958).

The range of excitation energies in Be^{7} from 3.28 to 4.73 MeV was investigated by Van de Graaff-accelerated He^{3+} ions scattered from He^{4} gas in a differentially pumped, large-volume scattering chamber. The second excited state in Be^{7} was studied, and its laboratory resonant energy and width were determined to be 5.17 and 0.180 MeV respectively, corresponding to an excitation energy in Be^{7} of 4.53 ± 0.02 MeV and a centre-of-mass width of 0.102 MeV. The spin and parity are $J = \frac{7}{2}^-$ and the reduced width is 3.0×10^{-13} MeV cm. The behaviour of the nonresonant phase shifts is shown to be qualitatively consistent with other known states in Be^{7} whose resonant energies lie outside the range of the present experiment.

539.17

3902. A STUDY OF THE ELASTIC SCATTERING OF 38 MeV ALPHA-PARTICLES FROM F^{19}.

J.Catalá, L.Miralles, J.Aguilar and M.de la Cuadra.

An.Real Soc. Espan. Fis. Quim., Vol. 54(A), No. 9-10, 255-62 (Sept.-Oct., 1958). In Spanish.

The α-particles accelerated in a cyclotron were scattered by gaseous CF$_4$ and absorbed in nuclear plates. On the basis of the optical formula for diffraction at an opaque disk, a radius of interaction of 5.1×10^{-13} cm was derived. L.Pincherle

539.17

3903. SCATTERING OF 18.7 MeV ALPHA PARTICLES FROM Al, Cu, AND Ag.

O.H.Gailar, E.Bleuler and D.J.Tendam.

Phys. Rev., Vol. 112, No. 6, 1989-93 (Dec. 15, 1958).

The scattering was studied from 10° to 170° with r.m.s. angular resolutions of 0.4° to 0.85°. The scattered alpha-particles were separated from singly charged reaction products with the aid of a proportional counter, and their energies were measured with a CsI(Tl) scintillation spectrometer. The elastic scattering for Ag shows the "exponential" drop-off from the Coulomb cross-section, without any pronounced structure at large angles. For Cu, definite changes in the slope of the drop-off are observed up to 120°, followed by a shallow minimum near 130° and a very deep, narrow minimum at 162° (c.m.). The interaction radii deduced from the strong-absorption model agree with those found at higher energies. From the diffraction-like pattern found for Al, an interaction radius of 6.4×10^{-13} cm is derived, appreciably larger than the one obtained at 40 MeV (5.4×10^{-13} cm). There are indications that a direct-process interpretation of the inelastic scattering from Al is possible.

539.17

3904. THE STRIPPING MECHANISM IN THE REACTION ^{9}Be(α,n)^{12}C.

N.W.Tanner.

Proc. Phys. Soc., Vol. 72, Pt 3, 457-9 (Sept., 1958).

Previous measurements of the angular distribution of neutrons from the reaction Be^{9}(α,n)C^{12} to determine the presence of stripping have been confused by contributions from resonant processes. In the present measurement the experimental conditions have been chosen to yield a simple form of the interference term from correlation theory as applied to stripping processes which is independent of the resonant processes. The (n-γ) correlation has been measured at two energies and the distribution found to be isotropic within 20%. From the conditions chosen, an amplitude for stripping of 10 → 20% relative to resonant processes would have shown up as a marked departure from isotropy. A.E.I. Research Laboratory

539.17

3905. NEUTRON SPECTRA AND DIFFERENTIAL CROSS SECTIONS OF THE REACTIONS ^{19}F(α,n)^{22}Na AND ^{27}Al(α,n)^{30}P.

R.Batchelor and J.H.Towle.

Proc. Phys. Soc., Vol. 13, Pt 2, 307-9 (Feb., 1959).

A time-of-flight spectrometer was used to measure differential cross-sections and neutron spectra for these reactions at angles 0°, 30°, 60°, 90° and 135° with values of E_α between 3.43 and 5.37 MeV. The angular distributions obtained for the groups corresponding to 0.59 MeV level in Na^{22} and the ground-state of P^{30} are not symmetrical about 90° suggesting interference from two levels of opposite parity in the compound nucleus. The Q-value of the Na^{22} reaction was measured as −1.94 ± 0.03 MeV, levels being located at 0.59 ± 0.02, 0.89 ± 0.02, 1.54 ± 0.03 and 1.97 ± 0.04 MeV, whilst some evidence was found of a level between 0.59 and 0.69 MeV, which is expected on theoretical grounds with T = 1, J = 0+. Q-value for the P^{30} reaction was estimated as −2.67 ± 0.03 MeV, levels being found at 0.70 ± 0.03 and 1.45 ± 0.03 MeV.

A.E.I. Research Laboratory

539.17

3906. REACTIONS OF URANIUM-238 WITH CARBON IONS.

T.Sikkeland, S.G.Thompson and A.Ghiorso.

Phys. Rev., Vol. 112, No. 2, 543-7 (Oct. 15, 1958).

The excitation functions for some reactions of U^{238} with monoenergetic C^{12} ions were measured by use of the stacked-foil technique. The (C,4n) and (C,6n) reactions were found to occur through the formation of a compound nucleus followed by neutron evaporation. The results were consistent with calculations made by a modified Jackson-type treatment. Application of the information from the U^{238}(C,xn) reactions to the calculation of cross-sections for the Pu^{242}(C,4n)Fm^{250} reaction was found to give agreement with experimental results. The (C,α4n) reaction probably proceeds mainly by a stripping mechanism, but there is also an indication of evaporation of alpha-particles from a compound system.

539.17

3907. ELASTIC SCATTERING OF C^{12} FROM GOLD.

E.Goldberg and H.L.Reynolds.

Phys. Rev., Vol. 112, No. 6, 1981-8 (Dec. 15, 1958).

The angular distribution of C^{12} ions elastically scattered by gold was measured at the following laboratory energies: 118 ± 2, 101 ± 2, 79.4 ± 3, and 73.6 ± 3 MeV. Heavy ions from the Berkeley heavy-ion linear accelerator (HILAC) were recorded in two Ilford E-1 plates from a scattering angle of 19° to 159°. In all cases the differential cross-sections exhibited a Coulomb-like behaviour at small angles, a rise above Coulomb of about 20% as the scattering angle increased, and then a rapid drop below Coulomb in much the same manner as alpha-particles scattered from heavy elements in the 20-40 MeV range. The Blair "sharp cutoff" model reproduces closely the character of the data; however, small oscillations predicted from the model are not experimentally observed. Interaction distances of (11.8 ± 0.3, 12.1 ± 0.3, 11.85 ± 0.4, and 1.85 ± 0.45) × 10^{-13} cm, respectively, for the foregoing energies are inferred from application of the Blair model.

539.17

908. A NOTE ON THE INELASTIC CONTRIBUTIONS TO THE ELASTIC SCATTERING OF HIGH-ENERGY ELECTRONS FROM HELIUM.

P.O.Davey and H.S.Valk.
Nuovo Cimento, Vol. 10, No. 5, 789-6 (Dec. 1, 1958).

An estimate is made of the contribution of non-radiative inelastic processes to the elastic scattering of high-energy electrons from He^4. It is shown that at the presently available energies and scattering angles the dominant process is electrodisintegration, and that this and other effects may be expected to give a correction to the differential elastic scattering cross-section of several percent, the maximum values occurring at high energies and backward scattering angles.

539.17

909. ELECTRODISINTEGRATION OF Be^9 AND C^{12}.

W.C.Barber.
Phys. Rev., Vol. 111, No. 6, 1642-50 (Sept. 15, 1958).

Yields from the reactions Be^9(e,e'n) and Be^9(γ,n), as well as the relative yields from C^{12}(e,e'n)C^{11} and C^{12}(γ,n)C^{11}, were measured under conditions which permitted a comparison of the relative effects of electrons and bremsstrahlung from electrons in producing nuclear reactions. The primary electron energies were from 6 to 17 MeV in the case of Be, and 24 to 145 MeV in the case of C. Comparison of the experimental results with the theory of electrodisintegration gives information about the multipole order of the electromagnetic transitions involved. The Be^9 results agree with theory if the reaction mechanism is predominantly electric-dipole. For C^{12}, a mixture of 92% electric-dipole with 8% electric-quadrupole intensities gives agreement with theory over the energy range 28-145 MeV, provided that the finite size of the C nucleus is taken into account. The method of considering the finite nuclear size in the theory is presented, and the results previously obtained by Reagan for the reactions F^{19}(e,e'2p)N^{17} and F^{19}(γ,2p)N^{17} are shown to be in good agreement with the modified theory for an electric-quadrupole transition.

539.17

3910. SUM RULES FOR INELASTIC ELECTRON SCATTERING.

S.D.Drell and C.L.Schwartz.
Phys. Rev., Vol. 112, No. 2, 568-79 (Oct. 15, 1958).

Sum rules are constructed for the analysis of inelastic electron scattering at high energy (~ 150 MeV) from light nuclei. Effects taken into account are: nucleon charge, recoil, and magnetic-moment currents; exchange currents; finite nucleon size; nuclear centre-of-mass motion; and the kinematical factors describing the correct relation between initial and final electron energies, the scattering angle, and the nuclear excitation energy. It appears that a sensitive test of the role of exchange currents in the nuclear ground state is provided by a sum rule for the energy-weighted cross-section for fixed-momentum transfer:

$$\sigma E = \int_{|q| = \text{const}} \epsilon\sigma(\epsilon,q)d\epsilon.$$

539.17

3911. EFFECT OF NUCLEAR DEFORMATION ON THE ENERGY OF THE PHOTONUCLEAR GIANT RESONANCE.

M.Fabre de la Ripelle.
C.R. Acad. Sci. (Paris), Vol. 247, No. 19, 1568-71 (Nov. 10, 1958).
In French.

A previous treatment (Abstr. 667/1959), giving correctly the giant photonuclear resonance energy for a spherical nucleus, is extended to the case of a deformed nucleus. The deformation gives rise to a splitting of the resonance energy; using the resonance width (Abstr. 673/1959) for a spherical nucleus, the separation of the two resonance energies is estimated and connected to the intrinsic quadrupole moment.

J.Lascoux

539.17

3912. ON THE CALCULATION OF THE PHOTONUCLEAR CROSS-SECTIONS FOR BREMSSTRAHLUNG RADIATION.

R.Basile, M.Gusakow and J.M.Lagrange.
C.R. Acad. Sci. (Paris), Vol. 248, No. 4, 89-92 (Jan. 5, 1959).
In French.

A method of inversion for the integral cross-section is proposed; the assumed spectrum being taken of the form

$$\frac{k[E_{max}](E_{max} - E)^{\alpha(E_{max})}}{E}$$

with $\alpha(E_{max})$ a linear function of E_{max}.

J.Lascoux

539.17 : 539.12

3913. ATTENUATION OF γ-RAYS FROM AN INFINITE PLANE. CORRECTIONS TO DATA SHEET NO. 25.

M.G.Chasanov and M.Shatzkes.
Nucleonics, Vol. 16, No. 10, 121 (Oct., 1958).

See Abstr. 8366 (1958).

R.D.Smith

539.17

3914. SEARCH FOR DELAYED NEUTRONS FROM THE PHOTON BOMBARDMENT OF LITHIUM.

G.W.Tautfest.
Phys. Rev., Vol. 111, No. 4, 1162-3 (Aug. 15, 1958).

A search has been made for delayed neutrons resulting from the reaction Li^7(γ,2p)H^5 in an effort to decide whether or not H^5 exists. Delayed neutrons were detected in a moderated counter assembly and scaled in nine delay channels which were variable in width and initial delay. A small signal observed after background subtraction showed no decay within statistics over a period of 0.45 sec. The first 0.05-sec counting period has been analysed for the presence of a decay of 0.01-sec half-life and compared with a predicted yield of the reaction Li^7(γ,2p) obtained by extrapolation of the measured yields of the reactions B^{11}(γ,2p) and F^{19}(γ,2p). The conclusion is that less than one per cent of the expected Li^7(γ,2p) yield can result in a particle-stable final state.

539.17 : 539.163

3915. PHOTONEUTRON REACTIONS IN N, O, F, Cu, Ag, AND In.

W.L.Bendel, J.McElhinney and R.A.Tobin.
Phys. Rev., Vol. 111, No. 5, 1297-1302 (Sept. 1, 1958).

Using an energy scale based on an electrical "zero" and the (γ,n) thresholds of F^{19}, N^{14} and C^{12}, five (γ,n) thresholds were measured: Ag^{109}, 9.14 ± 0.05 MeV; Ag^{107} to 24 min Ag^{106}, 9.43 ± 0.05; Cu^{65}, 9.89 ± 0.11; Cu^{63}, 10.80 ± 0.04; and In^{115} to 49 day In^{114m}, 9.22 ± 0.10. Breaks, interpreted to be levels in the initial nucleus, were found at 10.47 ± 0.02 MeV in F^{19} and 16.17 ± 0.05 MeV in O^{16}. The observed O^{16}(γ,n)O^{15} threshold was in poor agreement with the known Q value. Two half-lives were measured: F^{18}, 1.83 ± 0.02 hours and In^{114m}, 49 ± 1 days.

539.17

3916. PHOTONEUTRON YIELDS IN THE RARE-EARTH REGION.

E.G.Fuller, B.Petree and M.S.Weiss.
Phys. Rev., Vol. 112, No. 2, 554-60 (Oct. 15, 1958).

The total photoneutron yield curves for Sn, I, La, Ce, Sm, Tb, Ho, Er, Yb, Ta, Au and Pb were measured for X-ray energies from 7 to 40 MeV with about 1% statistical uncertainty. The Penfold—Leiss matrix was used to convert these yield curves to integrated neutron yield cross-sections directly without smoothing the original activation curves. The cross-sections derived from the integral curves were corrected for multiple neutron emission above the (γ,2n) threshold using the statistical model. The widths found for the giant resonances for the closed shell nuclei decreased from 5 MeV to 3.8 MeV in going from Sn to Pb. The widths for the elements having large nuclear deformations for most of their isotopes were considerably broader. These widths decreased slowly from 8.6 MeV for Sm to 6 MeV for Ta. These widths are consistent with the broadening of the giant resonance to be expected on the Danos model if values of the intrinsic quadrupole moment are taken from Coulomb excitation data. The neutron yield cross-sections corrected for multiple neutron emission were integrated to 22 MeV. Using these integrals and defining f by $\int\sigma dE = 0.06(NZ/A)f$, these data gave an average value of f = 1.34 ± 0.21.

539.17

3917. PHOTOEXCITATION OF Pb^{207m}.

U.Farinelli, F.Ferrero, R.Malvano, S.Menardi and E.Silva.
Phys. Rev., Vol. 112, No. 6, 1994-8 (Dec. 15, 1958).

The 0.8 sec isomeric activity in lead was excited by the photoneutron reaction in Pb^{208} and the relative cross-section is calculated from the measured yield. The cross-section presents an extremely sharp peak in the giant resonance region with half-width not greater than 2 MeV. The isomeric level excitation efficiency, $\sigma(\gamma,n\gamma')/\sigma(\gamma,n)$, is calculated: it reaches a maximum value of 5%, which may be compared with the same quantity relative to inelastic neutron scattering in Pb^{207}, that already at the energy of 11 MeV, in the compound system, assumes a 14% value. A discussion is given to explain the complete disagreement between the above two values of the excitation efficiency, which is attributed to the difference in angular momentum transferred to the compound system in the above two reactions.

539.17

3918. THE (γ,n) AND $(\gamma,2n)$ REACTIONS IN ^{141}Pr.
J.H.Carver and W.Turchinetz.
Proc. Phys. Soc., Vol. 73, Pt 1, 110-12 (Jan., 1959).

These reactions were induced by bremsstrahlung up to 33 MeV, the decay of the resulting 3.4 min Pr^{140} and 4.5 hr Pr^{139} being followed by observing the K-capture X-rays with a scintillator. Absolute yields were computed, and the cross-section curve derived. Above the giant resonance for the (γ,n) reaction, the cross-section remains appreciable well above the $(\gamma,2n)$ threshold, where the latter process should predominate under statistical conditions. In this region, then, the (γ,n) cross-section must be due to direct interaction, and only $(\gamma,2n)$ involves a compound nucleus. Comparison of these results for Pr^{141} (closed neutron shell) with earlier work on Ta^{181} (midway between shells) suggests that direct emission may be more probable for closed shell nuclei. A.E.I.Research Laboratory

539.17 : 539.12

POLARIZATION OF THE PROTON FROM PHOTODISINTEGRATION OF THE DEUTERON. See Abstr. 3742

539.17

3919. STUDY OF γ-RAYS PRODUCED BY INELASTIC SCATTERING OF FAST NEUTRONS.
B.Milman, G.Amsel and M.C.Loyau.
J. Phys. Radium, Vol. 20, No. 1, 51-9 (Jan., 1959). In French.

The γ-ray spectra resulting from the (n,n') reaction have been investigated for the following nuclei: Fe, Al^{27}, F^{19}, Mn^{55}, Cu, Co^{59}, P^{31} and As^{75}, for a primary neutron energy of 2.7 MeV. The observed transitions allow the level schemes of these nuclei to be completed.

539.17

3920. EFFECTIVE CROSS SECTIONS FOR THERMAL SPECTRA.
C.H.Westcott.
Nucleonics, Vol. 16, No. 10, 108-10 (Oct., 1958).

Cross-sections for Sm, Gd, U^{235} and the isotopes of Pu in a Maxwellian neutron spectrum (with and without an epithermal 1/E component) at temperatures from 20° to 760°C are presented graphically. R.D.Smith

539.17

3921. ON THE MECHANISM OF THE (n,2n) REACTION AT 14 MeV NEUTRON ENERGY. II. K.Winter, B.Torki and E.Remy.
Nuovo Cimento, Vol. 11, No. 1, 1-11 (Jan. 1, 1959).

For Pt I see Abstr. 681 (1959). The correlation of the respective directions of emission of the two neutrons in the Be^{9}(n,2n)Be^{8} reaction was investigated by using coincidence detection of the outgoing neutrons. In an azimuthal plane, separation angles ranging from 45° to 90° are predominant; a maximum correlation of (20 ± 3)% is obtained at 60°. This angular correlation is attributed to simultaneous emission of two neutrons. Angular distribution measurements on the same reaction proved, by using time-of-flight techniques, that second neutrons are emitted by a compound nucleus, whereas first neutrons are emitted both directly and by a compound nucleus.

539.17 : 539.12

3922. PROTON DISTRIBUTIONS FROM S^{32}(n,p)P^{32}.
H.P.Eubank, R.A.Peck, Jr and F.L.Hassler.
Nuclear Phys., Vol. 9, No. 2, 273-86 (Dec. [1], 1958).

Energy spectra of protons from natural sulphur bombarded with 14 MeV neutrons are shown at 0°, 30°, 60°, and 90°, obtained with a CsI scintillation spectrometer in coincidence with two particle-defining proportional counters. The observed characteristics are those of direct interaction, and the total energy spectrum is well fitted by the level density formula of Newton. The energy discrimination interval being broad but fairly sharp at its extremes, energy groups are not resolved but angular distributions for successive spectral intervals show marked changes at certain energies. From these abrupt changes and the known resolution characteristics the strongest contributing levels in P^{32} are located and assigned l values. The levels so deduced match the strongest contributors to (d,p) and (n,γ) processes leading to P^{32} and fit quantitatively the expected pattern of single-particle transitions. Evidence is found of participation of protons from two initial states as expected, so that three final neutron levels account for five distribution components. All single-particle excitations appear in the sequence expected except 2p$_{\frac{3}{2}}$ (neutron), which seems to occur before 1f$_{\frac{7}{2}}$. Integration of the spect gives a mean "nuclear temperature" of 2.1 MeV and a cross-section of 185 ± 30 millibarns for the first 9.5 MeV of residual excitation.

539.17

3923. THE RESONANCE ABSORPTION IN HETEROGENEOUS SYSTEMS. G.Memmert.
Nukleonik, Vol. 1, No. 2, 48-57 (July, 1958). In German.

The resonance integral for neutrons in cylinders and spheres of uranium was determined by a method in agreement with the theory o Gurevich and Pomeranchouk. From the experimental form of the resonance integral for uranium metal, the resonance integral was deduced for cases in which neutron scattering is important, e.g. for mixtures of uranium with light-elements (oxygen, carbon, etc.) and hollow cylinders filled with moderators. These results were shown to be in direct agreement with the experimental results of Hellstrand D.H.Lord

539.17

3924. NEUTRON NONELASTIC CROSS SECTIONS AT 21.0, 25.5, AND 29.2 MeV. M.H.MacGregor, W.P.Ball and R.Booth.
Phys. Rev., Vol. 111, No. 4, 1155-62 (Aug. 15, 1958).

Neutron nonelastic collision cross-sections for eleven elements have been measured in the energy range 21-29 MeV. Corrections were applied to the data by means of a UNIVAC calculation. Since no experimental neutron angular distributions are available in this energy region, optical-model calculations were used for the correction problem. In general the cross-sections at 25 MeV are 10% to 20% lower than at 14 MeV.

539.17

3925. ASYMMETRY MEASUREMENTS IN THE SCATTERING OF 155 MeV NEUTRONS BY CARBON, ALUMINUM, COPPER, CADMIUM AND LEAD. R.S.Harding.
Phys. Rev., Vol. 111, No. 4, 1164-9 (Aug. 15, 1958).

The asymmetry in the scattering of a 13% polarized (155 ± 5) MeV neutron beam from C, Al, Cu, Cd, and Pb was measured at angles below the first maximum in the asymmetry. The scattered neutrons were detected by a large volume scintillator with an energy threshold determined by pulse-height discrimination. Optical-model calculations were performed by a W.K.B. phase-shift analysis to find the "best fit" to the 155 MeV proton—carbon polarization data from Uppsala. The nuclear parameters determined in this manner were then used to calculate the polarization and the cross-sections by W.K.B. and Born approximations for comparison with the data of this experiment. The neutron polarization and the qualitative behaviour of the neutron differential cross-sections were well explained by the model, but sizeable discrepancies were found between the predicted and measured absolute cross-sections.

539.17 : 539.12

A 140 kV NEUTRON GENERATOR. See Abstr. 3751

539.17

3926. PRELIMINARY RESULTS ON NUCLEAR INTERACTIONS OF K^{+}-MESONS IN THE ENERGY REGION 240-300 MeV.
D.Keefe, A.Kernan and A.Montwill.
Nuovo Cimento, Vol. 10, No. 3, 538-40 (Nov. 1, 1958).

The interactions of 240-300 MeV K^{+}-mesons with emulsion nuclei are studied. The amount of charge-exchange scattering is found to be considerably greater than at lower energies, indicating the importance of the T = 0 state. C.J.Batty

539.17

3927. ELASTIC DIFFERENTIAL CROSS-SECTION FOR 60 MeV K^{+}-SCATTERING IN EMULSION. T.G.Lim and J.P.van der Linden.
Nuovo Cimento, Vol. 11, No. 1, 67-72 (Jan. 1, 1959).

By the method of the phase-shift optical model analysis, the differential cross-sections for 60 MeV K^{+}-mesons elastically scattered by complex nuclei in Ilford G-5 nuclear emulsion are computed. The calculations are based on the assumption that the elastic scattering is due to a symmetrical square well potential of +13 MeV, superposed on the Coulomb potential. The resultant emulsion cross-section $d\sigma/d\omega = f(\theta)$ curve is obtained from the separate contributions of the cross-sections for the K^{+}-meson scattering by C, Ag, Br and O. Previously the resultant cross-sections were computed by Costa and Patergnani on the assumption that the K^{+}-mesons were scattered by the hypothetical elements E^{95} and E^{14}, representing the average of the heavy and the light elements in the emulsion, respectively. It is found that the $d\sigma/d\omega = f(\theta)$ curves obtained by their method and by the present ones do not coincide but agree fairly well.

539.17

3928. SCATTERING OF 80 MeV π^- MESONS BY COMPLEX NUCLEI:

W.F.Baker, J.Rainwater and R.E.Williams.

Phys. Rev., Vol. 112, No. 5, 1763-72 (Dec. 1, 1958).

The elastic scattering of 80 MeV π^- mesons by lithium, carbon, aluminium, and copper was investigated using a π^- detector which gave improved discrimination against low-energy-loss inelastic events. A "transmission" scaterer orientation was necessary to maintain energy resolution, so only less than 120° scattering was studied. The new differential scattering cross-sections for lithium, aluminium, and copper agree with the previously reported results at small angles but are 2 to 10 times smaller at larger angles. There are indications of diffraction structure in aluminium and copper which were not previously observed due to the poorer energy resolution of the earlier measurements. Including the incident beam energy spread, the detector sensitivity is down by factors f 3 and 9 for E ± 5.0 MeV and E ± 10 MeV when peaked for mean energy E. This was used to separate the scattering from carbon into elastic and inelastic components for excitation of the 4.43 and (7.65 and 9.61) MeV levels. Inelastic scatterings from lithium were also studied. For the same momentum transfer on scattering, the ratio of the inelastic scattering with excitation to the 4.43 MeV and 9.61 MeV levels to the elastic differential scattering cross-section is the same, within experimental accuracy, as found by Fregeau for the scattering of 187 MeV electrons on carbon. The elastic scattering is compared with the results of complex square-well phase-shift calculations, and with diffuse-edge optical model and modified Kisslinger model calculations.

539.17

3929. THEORETICAL CALCULATIONS OF THE SCATTERING OF π^- MESONS BY COMPLEX NUCLEI.

W.F.Baker, H.Byfield and J.Rainwater.

Phys. Rev., Vol. 112, No. 5, 1773-8 (Dec. 1, 1958).

The angular distributions of 80 MeV negative pions elastically scattered from Li, C, and Al are analysed on the basis of optical models by using I.B.M. 650 computers. It was not possible to fit the data with the usual $V_1 + iV_2$ type model having either a square or diffuse edge and V_1 and iV_2 proportional to the nuclear density. A Kisslinger-type model, which takes better account of the p-wave nature of the basic π—nucleon scattering process, was also used with a modification to avoid a physically unreasonable behaviour of the effective interaction. Using $r_0 = 1.08$ and a diffuseness parameter $a = 0.25$ in a Saxon-type density distribution, good agreement with experimental data was obtained.

539.17 : 539.12

PION—DEUTERON SCATTERING. See Abstr. 3775

539.17

3930. NUCLEAR INTERACTIONS IN THE ENERGY REGION $(10^{10}\div10^{14})$ eV.

P.Ciok, T.Coghen, J.Gierula, R.Hołyński, A.Jurak, M.Mięsowicz, T.Saniewska and J.Pernegr.

Nuovo Cimento, Vol. 10, No. 5, 741-54 (Dec. 1, 1958).

Measurements were made of the angular distributions of secondary particles in interactions of high energy primaries of cosmic radiation with the nuclei of photographic emulsion. A systematic increase in anisotropy of angular distribution in c.m. with increasing primary energy was found. It was found that in many high energy jets the number of secondaries in the vicinity of $\pi/2$ c.m. angle is smaller than that predicted by the theories of Heisenberg or Landau. For explaining these experimental results a model is introduced in which the secondaries are emitted isotropically from two centres moving in opposite direction in the c.m. system. Some experimental arguments are given for this isotropy. The relation between the velocity of two centres, the inelasticity coefficient, multiplicity and transversal momenta of secondaries is discussed.

539.17

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also the Section entitled "COSMIC RAYS".

539.17

3931. PROCEEDINGS OF THE SYMPOSIUM ON THE PHYSICS OF FISSION HELD AT CHALK RIVER, ONTARIO, MAY 14-18, 1956.

Edited by G.C.Hanna, J.C.D.Milton, W.T.Sharp, N.M.Stevens and E.A.Taylor.

Atomic Energy Canada Rep. 329, 414 pp. (July, 1956).

Eighteen papers were presented and discussed, dealing, inter alia, with: liquid drop model; angular distribution and kinetic energy of fission fragments; photofission; nuclear charge distribution in thermal neutron fission; statistical weights and Coulomb factors for fission modes; collective model and fission; distortion of heavy nuclei.

539.17

3932. SPALLATION-FISSION COMPETITION IN HEAVIEST ELEMENTS; HELIUM-ION-INDUCED REACTIONS IN URANIUM ISOTOPES.

R.Vandenbosch, T.D.Thomas, S.E.Vandenbosch, R.A.Glass and G.T.Seaborg.

Phys. Rev., Vol. 111, No. 5, 1358-73 (Sept. 1, 1958).

A radiochemical study of fission and spallation products produced by bombardment of U^{233}, U^{235}, and U^{238} with 18-46 MeV helium ions has been made. As in the case of similar studies using isotopes of pluotonium as targets, most of the reaction cross-section is taken up by fission. Also, the pronounced increase of the total cross-section for (α,xn) reactions with increasing mass number of the target that was observed for plutonium targets is observed for uranium targets. Excitation functions for $(\alpha,2n)$, $(\alpha,3n)$, and $(\alpha,4n)$ reactions are interpreted in terms of compound-nucleus formation and fission competition at the various stages of the neutron evaporation chain. The importance of neutron binding energies for the competition between fission and neutron emission is stressed. An existing model for neutron evaporation following compound-nucleus formation has been extended to include the effect of fission competition. Results of calculations based on this model show good agreement with those features of the (α,xn) excitation functions believed to result from compound-nucleus formation. These calculations also show that fission usually precedes neutron evaporation for helium-ion-induced reactions of U^{233} and U^{235}. The excitation functions for the (α,n), (α,p), $(\alpha,pn + \alpha,d)$, $(\alpha,p2n + \alpha,t)$, and $(\alpha,p3n+\alpha,tn)$ reactions are discussed in terms of direct interaction mechanisms involving little competition from fission. Fission shows an increase in symmetry with energy and becomes symmetrical at about 40 MeV energy of the helium ions. There is no significant difference in the symmetry of fission for the three uranium isotopes. Total reaction cross-sections, including those for both fission and spallation reactions, indicate a nuclear radius parameter r_0 slightly larger than 1.5×10^{-13} cm.

539.17 : 539.12

3933. NEUTRON MULTIPLICATION IN SMALL SPHERES OF FISSIONABLE MATERIAL.

P.J.Bendt and R.E.Peterson.

J. appl. Phys., Vol. 29, No. 9. 1271-7 (Sept., 1958).

Central-source neutron multiplication measurements were made on small spheres of U^{233}, U^{235}, U^{238}, and Pu^{239}. Measurements were made on four sizes of spheres, varying approximately from 1 in. to 2.5 in. in diameter. In the case of U^{233}, only one sphere, 1.245 in. in diameter, was available. The three neutron sources, mock-fission, Po—Li, and Po—Be, were 0.4 in. diameter spheres. They have widely different neutron spectra. Multiplications were measured with a flat-response long counter, and with U^{235}, U^{238}, and Np^{237} spiral fission chambers, under conditions such that the error introduced by room scattered neutrons was negligible. Results of the multiplication measurements are given. The measurements have been analysed to obtain the leakage spectra from the spheres in terms of three velocity groups. The Np^{237} and U^{238} fission chambers serve as threshold detectors defining the lower energy of the second and third velocity groups, respectively.

539.17

3934. THERMAL-NEUTRON-INDUCED FISSION OF Th^{229}.

A.Smith, P.Fields, A.Friedman and R.Sjoblom.

Phys. Rev., Vol. 111, No. 6, 1633-5 (Sept. 15, 1958).

A back-to-back ionization chamber is used to measure the Th^{229} fission fragment kinetic energy distribution. This fission process is found to be the most asymmetric known, with a most probable mass ratio of 1.57. The measured total fragment energy is 160.2 ± 3 MeV. The experimental results are compared with the characteristics of other fission processes and with theory.

539.17 : 539.217

3935. DIFFUSION OF THE FISSION XENON FROM METALLIC URANIUM.

K.E.Zimen and L.Dahl.

Z. Naturforsch., Vol. 12a, No. 2, 167-9 (1957). In German.

Presents the results of investigation of the diffusion of Xe^{133} from U metal of reactor purity, irradiated with neutrons, in the temperature interval 570-1000°C. The following formula has been developed for the coefficient of diffusion $D = 2.4 \times \exp(-2.6/RT)$ cm^2/sec, the energy of activation being 2.6 eV/atom. F.Lachman

539.17

3936. FUSION CHAIN REACTION. CHAIN REACTION WITH CHARGED PARTICLES.

M.Gryziński.

Nukleonika, Vol. 3, Special Number, 28-38 (1958).

Equations, based on the variation of plasma stopping power with electron temperature and density, are given, which determine conditions for a divergent chain reaction to occur. These are illustrated by the case of a 50% D–T mixture where the chain reaction depends on recoil nuclei produced by moderation of the 14 MeV D–T neutrons; critical temperature is about 10^7 ° K at low densities, and the critical density is about 10^{27} cm^{-3} at 0° K. R.S.Pease

539.17

3937. THE REACTION $Be^9(n,2n)Be^8$ IN HETEROGENEOUS THERMAL REACTORS MODERATED WITH BERYLLIUM.

I. EFFECT ON k_∞. P.Saraiva de Toledo;
II. CALCULATION OF THE FAST FISSION FACTOR.
D.Dillenburg, G.Jacob and P.Saraiva de Toledo.
An Acad. Brasil Cienc., Vol. 30, No. 2, 137-46, 147-53 (1958).
In Portuguese.

The theory is developed on conventional lines. The effect on the multiplication factor is to increase it by about 7%, in agreement with the conclusions of other workers. L.Pincherle

539.17 : 539.12

3938. NEUTRON DIFFRACTION AT A HIGH-FLUX REACTOR.

G.E.Bacon and R.F.Dyer.
Nature (London), Vol. 183, 35 (Jan. 3, 1959).

Up to the present practically all neutron diffraction studies have been carried out with neutron beams from reactors which have a peak flux of a few times 10^{12} neutrons cm^{-2} sec^{-1}. Preliminary measurements have now been made with a spectrometer at the Harwell research reactor DIDO, where a peak unperturbed flux of about 5×10^{13} neutrons cm^{-2} sec^{-1} is available, resulting in a 20-fold increase in neutron beam intensity over that obtained with BEPO. As a result much smaller samples of material may be investigated. The advantages of this for studies of magnetic materials and single crystals are discussed. A description of the spectrometer, with an account of the problems posed by the higher flux, is to be published elsewhere. A.E.I. Research Laboratory

539.17

3939. Ag–In–Cd COULD REPLACE Hf FOR PWR CONTROL RODS.

I.Cohen, E.F.Losco and J.D.Eichenberg.
Nucleonics, Vol. 16, No. 8, 122-7 (Aug., 1958).

Physical and mechanical properties, together with the results of corrosion and irradiation tests are reported. R.D.Smith

539.17

3940. REACTOR KINETIC FUNCTIONS: A NEW EVALUATION.

G.R Keepin and T.F.Wimett.
Nucleonics, Vol. 16, No. 10, 86-90 (Oct., 1958).

The relative amplitudes and periods of six delayed neutron groups from Th^{232}, U^{233}, U^{235}, U^{238}, Pu^{239} and Pu^{240} are listed. The relationship between reactor period and reactivity for reactors fueled with these isotopes has been computed and the results are presented graphically. The variation in neutron density resulting from a small sinusoidal variation in frequency (the transfer function) has also been computed and curves showing the variation of amplitude and phase with frequency are given. R.D.Smith

539.17

3941. EFFECTIVE-ENERGY METHOD FOR SPENT-FUEL SHIELDING.

R.L.Ashley.
Nucleonics, Vol. 16, No. 10, 78-81 (Oct., 1958).

A curve computed from the yields of hard γ-ray (> 1.5 MeV) emitting fission products is first used to determine the photon-emission power as a function of irradiation time and decay time. A second set of curves enables an effective photon energy (having the same attenuation in a particular shield as the mixture of emitted γ-rays) to be determined. These curves are presented for lead of thickness 6-12 inches, water 6-12 ft, concrete 3-6 ft and magnetite concrete 2-4 ft. The dose rate computed in this way is reasonably accurate for decay times > 45 min. R.D.Smith

539.17

3942. SHIELDING-GLASS BUILDUP FACTORS.

J.W.Lindner.
Nucleonics, Vol. 16, No. 10, 77 (Oct., 1958).

Curves giving buildup factors for glasses of densities 2.7, 3.3 and 6.2 as a function of thickness expressed in relaxation lengths. An accuracy of better than 15% is obtained for thicknesses up to 20 relaxation lengths. R.D.Smith

539.17

3943. SHIELDING THE ENRICO FERMI FAST BREEDER REACTOR.

H.E.Hungerford and R.F.Mantey.
Nucleonics, Vol. 16, No. 11, 120-5 (Nov., 1958).

The shield system is designed for 430 MW (Th) operation and a life of 20 years. It consists of a 12 in. stainless steel thermal shield inside the primary containment vessel, a graphite shield about 4 ft thick, of which the inner and outer 6 in. layers are boron impregnated, a secondary shield of 30 in. of concrete protected by steel cladding, and biological shield of 6 ft of concrete. Twenty-group diffusion theory was used to calculate the neutron fluxes in the primary shield; various conventional methods were used for the flux in the outer part of the shield. The neutron fluxes, heat production and temperature distribution in the various parts of the shield are shown graphically. R.D.Smit

539.1

3944. CRITERIA FOR TEST REACTORS.

B.Wolfe.
Nucleonics, Vol. 16, No. 11, 135-7 (Nov., 1958).

Research reactors are usually designed so that the maximum number of neutrons is absorbed in the experimental loading. It is shown that the thermal utilization, and hence the neutron leakage from the fuel regions should be high. The effect of reflectors is to reduce neutron leakage into beam ports, and unless there is sufficient neutron absorption in the experiments loaded in the core to keep the fuel loading high, to reduce the neutron current into in-core experiments. The use of a low absorption moderator, which results in a low fuel loading and a high flux density, is most useful where high fluxes in small samples are required. This type of reactor shows large flux depressions if large absorbers are present. R.D.Smith

539.17

3945. THE DESIGN OF NATURAL URANIUM, HEAVY WATER RESEARCH REACTORS FROM THE PHYSICIST'S VIEWPOINT.

K.Meetz and W.Häfele.
Nukleonik, Vol. 1, No. 1, 1-9 (April, 1958). In German.

In the design of research reactors physics questions arise which have to be systematically answered. The authors are concerned with a cylindrical reactor with axial and radial reflectors. The coolant, moderator and reflectors are heavy water; the fuel elements are rods of natural uranium canned in aluminium and arranged on a square lattice. Graphs are presented which are the result of considering the system with seven variable parameters: power, height of core, radius of core, the axial and radial reflector savings, the radius of the uranium rod and the radius of the "equivalent cell". The objectives of the design study were a built-in reactivity of 10%, the maximum temperature of the aluminium had to be not nearer than 100° C to the melting point, also the maximum thermal and fast fluxes had to be made as large as possible. These requirements are discussed in the light of the results presented. A.J.Salmon

539.17

3946. REMARKS ON THE THEORY OF RESONANCE ESCAPE IN HOMOGENEOUS REACTORS.

W.Oldekop.
Nukleonik, Vol. 1, No. 1, 19-21 (April, 1958). In German.

This paper shows that a reasonably accurate estimate of the resonance escape probability, p, in homogeneous reactors can be obtained using a modified version of the well-known approximate expression for p. No special suppositions are made about the effective cross-sections. The modification is a new function for the resonance integral. This function is derived and it is shown that the maximum error involved in its use is small, in the case of a heavy water moderated reactor less than 2%. A.J.Salmon

539.17

3947. THE RECOVERY OF NUCLEAR FUELS.

L.Küchler and W.Schüller.
Nukleonik, Vol. 1, No. 3, 112-24 (Aug., 1958). In German.

This report deals with the technical and economical aspects of the recovery of fissionable material from used fuels which must be replaced when their content of fissionable material has fallen below a critical value while they have become enriched in fission products of high absorptivity for neutrons. The solvent extraction method for uranium and plutonium is described in detail. The answer to the question whether there should be one centre for recovery or individual plants at each power station depends upon the quantity of material which has to be processed and also on the possibility of working up different types of used fuel in one plant. R.Schnurmann

539.17

3948. DIFFUSION THEORY OF FINITE, HETEROGENEOUS REACTOR CONFIGURATIONS.

B.Sturm.
Nukleonik, Vol. 1, No. 4, 131-9 (Dec., 1958). In German.

The method of Meetz for calculating the eigenfunctions and eigenvalues for finite lattices in finite moderators is broadened by the inclusion of resonance absorption. This is particularly necessary in considering perturbed lattices, because of the resulting changes in the probability of resonance transitions. In this analysis, fuel plates or rods are considered as being replaced by source and sink surfaces or lines and effective fission and absorption cross-sections are defined. These equivalent lattices give the true neutron flux density in the moderator, and by extrapolation, in the fuel. D.H.Lord

539.17 : 539.12

SPHERICAL HARMONICS METHOD FOR NEUTRON-TRANSPORT PROBLEMS IN CYLINDRICAL GEOMETRY. See Abstr. 3747

539.17 : 539.12

INVESTIGATION OF INELASTIC MODERATION OF FAST NEUTRONS. See Abstr. 3749

539.17 : 621.317.79 : 621-52

3949. VARIATION OF THE TRIP POINT IN THE ORNL-TYPE SAFETY SYSTEM. J.L.Cockrell and C.W.Ricker.

Trans Amer. Inst. Elect. Engrs I, Vol. 77, 699-703 (1958) = Commun. and Electronics, No. 39 (Nov., 1958).

A multichannel trip system is described for shutting down a reactor by releasing neutron absorbing rods into the pile. An "auctioneering" principle is used whereby the information from each channel is pooled and the system controlled by the "highest bidder". The method of setting up such a system is described and the performance analysed. A.E.I. Research Laboratory

539.17 : 537.56

3950. NEW INVESTIGATIONS WITH SCEPTRE III.

Nature (London), Vol. 183, 7-10 (Jan. 3, 1959).

AXIAL POSITIVE ION VELOCITIES IN SCEPTRE III.
T.P.Hughes and S.Kaufman (7-8).

The Doppler widths of the O V lines excited in the toroidal discharge of Sceptre III were measured and indicated a temperature of about 10^6 °K for the plasma if the effects of broadening due to random mass motion from one discharge to another can be discounted. The shift in the wavelength of these lines when viewed tangentially to the direction of flow of positive gas current and in the opposite direction indicated that the emitting ions were travelling with a mean velocity of between 1 and 2×10^6 cm/sec in the direction of positive gas current flow.

POSITIVE ION HEATING MECHANISM IN SCEPTRE III.
A.A.Ware (8-10).

It is shown that, because of the loss of electrons to the walls of a toroidal discharge tube, the positive ions can carry an abnormal fraction of the gas current and consequently receive a substantial fraction of the energy input directly from the electric field. This could account for the fact that ion temperatures measured by Doppler broadening are much higher than estimates of electron temperatures. A.E.I.Research Laboratory

ATOMS

539.18

3951. THE COHERENT SCATTERING COEFFICIENT IN THE THOMAS—FERMI MODEL. L.Kolodziejczyk.

Ann. Phys. (Leipzig), Folge 7, Vol. 2, No. 1-2, 54-6 (1958). In German.

This is calculated analytically for free neutral atoms and for all wavelengths, using the Rozental approximation for the T—F function, agreeing with the results of Debye (1930) and Franz (1935) for particular wavelengths. J.Hawgood

539.18

3952. FERMI—THOMAS MODEL WITH CORRELATIONS. H.W.Lewis.

Phys. Rev., Vol. 111, No. 6, 1554-7 (Sept. 15, 1958).

The Fermi—Thomas—Dirac equation is modified to include correlations between electrons. An application is made to the equation of state. No numerical work with the modified equation is reported.

539.18

3953. ASYMPTOTIC SOLUTION OF THE THOMAS—FERMI EQUATION FOR LARGE ATOM RADIUS.

J.J.Gilvarry and N.H.March.

Phys. Rev., Vol. 112, No. 1, 140-9 (Oct. 1, 1958).

The general form of the solution ϕ of the Thomas—Fermi equation in the limit of large atom radius x_b is determined as an asymptotic series valid for points x near the atom boundary, by a perturbation on the Sommerfeld inverse-cube form. This generalization of the Coulson—March solution yields the complete form of that part of the asymptotic solution which depends on disposable constants of integration (two in number). The general terms of the series are determined explicitly, and coefficients of leading terms are given numerically as ratios in terms of the disposable constants. The two constants of integration are fixed simultaneously, in general, by the requirement of continuity in value and slope of ϕ with the results of a series solution for small x, and by the boundary condition. The general method of obtaining the two constants of integration for a compressed atom as power series in an inverse power $x_b^{-\lambda^2}$ of x_b is outlined, where $\lambda_2 = \frac{1}{2}(73^{\frac{1}{2}} - 7)$; coefficients of leading terms are calculated by making use of numerical results of Kobayashi et al. The products $x_b^3\phi_b$, where ϕ_b is the boundary value of ϕ, and $x_b^7(\phi_i' - \phi_{i,\infty}')$, where $\phi_i' - \phi_{i,\infty}'$ is the difference of the initial slope of ϕ from its value for an isolated atom, are each represented as an asymptotic power series in $x_b^{-\lambda^2}$ for x_b large. The two leading coefficients in the former series and the leading coefficient in the latter are determined numerically to relatively high accuracy and compared with values obtained by Gilvarry from the approximate solution of Sauvenier. The results are used to construct a fitted function for ϕ_b in which only one of five terms appearing is evaluated empirically, and which reproduces accurate numerical values of ϕ_b from solutions of the Thomas—Fermi equation within 0.1%, in general. This accuracy exceeds by a factor of about ten that obtained previously by March and by Gilvarry with fitted functions containing three and two theoretical terms, respectively. The connection between the general asymptotic solution and previous approximate results is discussed.

539.18

3954. TIGHT-BINDING CORRECTIONS OF STOPPING POWERS. W.Brandt.

Phys. Rev., Vol. 112, No. 5, 1624-6 (Dec. 1, 1958).

Theoretical tight-binding corrections for the stopping-power deficiency of inner-shell electrons at low particle velocities are compared with the experimental data measured by Burkig and MacKenzie for 20 MeV protons and by Bakker and Segrè for 300 MeV protons. Walske's accurate tight-binding corrections for K and L shells are found to be in complete agreement with experiment under conditions where only K and L shells are stopping-power deficient. If a larger fraction of the electron cloud of heavy atoms is deficient, extrapolations of Walske's corrections beyond their intended validity range underestimate the stopping-power deficiency. The stopping-power deficiency of heavy elements is well described by a cutoff approximation by Lindhard and Scharff of the tight-binding corrections of the statistical atom. "Best" tight-binding corrections are recommended and areas for further theoretical work indicated. After correction for valence and tight-binding effects, the mean excitation potentials I_0 from both sets of experimental data are in mutual agreement. The decrease of I_0/Z with increasing Z confirms the $Z^{-2/3}$ dependence of the exchange effects in the statistical atom.

539.18

3955. PRELIMINARY CLASSIFICATION OF THE SINGLY IONIZED PLUTONIUM ATOM (Pu II). J.R.McNally,Jr and P.M.Griffin.

J. Opt. Soc. Amer., Vol. 49, No. 2, 162-6 (Feb., 1959).

A preliminary energy level scheme for Pu II is established based on 125 Zeeman patterns obtained with an echelle Littrow spectrograph and a magnetic field of approximately 24 000 oersteds. The low electronic configuration involves the $^{6,8}F$ terms from $5f^67s$. Seven low even levels and 84 high odd levels are given.

539.18

3956. STRUCTURE OF THE METASTABLE STATE OF Mn^{++} AND Fe^{+++}. A.M.Clogston.

J. Phys. Chem. Solids, Vol. 7, No. 2-3, 201-6 (Nov., 1958).

A discussion is presented of the possibility of performing spin-resonance experiments on various metastable excited states of ions of the configuration $(3d)^n$. There appears to be no reason why such experiments should not be feasible. A special study is made of the ions Mn^{++} and Fe^{+++} with configuration $3d^5$. Observations on the metastable levels of these ions would be particularly useful in understanding the splittings of the ground state ^6S.

539.18

3957. ELECTRON AFFINITY OF ATOMIC LITHIUM. E.Holøien.

Nature (London), Vol. 183, 173 (Jan. 17, 1959).

Using results of a variational calculation on H^- (Abstr. 1993/1958), that is considering the K-shell in Li^- as effectively at the nucleus, the electron affinity $E(Li \rightarrow Li^-) = 0.81$ eV was obtained, in good agreement with experiment. The effect of the K-shell is being investigated. L.Pincherle

539.18 : 539.19 : 537.533

3958. MEASUREMENT OF ATOMIC AND MOLECULAR EXCITATION BY A TRAPPED-ELECTRON METHOD. G.J.Schulz.

Phys. Rev., Vol. 112, No. 1, 150-4 (Oct. 1, 1958).

A trapped-electron method is used to study inelastic processes in helium, mercury, and hydrogen. In this method, an electron beam traverses an electric and magnetic field configuration in which the low-energy electrons resulting from inelastic collisions are prevented from reaching the electron beam collector by a potential well. The low-energy electrons can reach a cylindrical collector surrounding the electron beam. The collection efficiency appears to be close to unity for electrons in the range 0 to 0.1 electron volt and zero at higher energies. The design of the tube and applied potentials determine the range of collection. A complete spectrum of energy levels is obtained in He, Hg, H_2, within the resolution of the instrument (better than 0.2 eV). The experiment yields approximate slopes of the resolved excitation functions near threshold. The method is well suited for a study of excitation events in molecules.

539.18

3959. MAGNETIC MOMENT OF HELIUM IN ITS $^3S_1$ METASTABLE STATE. C.W.Drake, V.W.Hughes, A.Lurio and J.A.White.

Phys. Rev., Vol. 112, No. 5, 1627-37 (Dec. 1, 1958).

The ratio of the electronic g_J value of He in its 1s2s, $^3S_1$ metastable state to the g_J of H in its ground state was redetermined by the atomic beam magnetic resonance method using separated oscillating fields. At magnetic fields of about 540 and 575 gauss the transitions $\Delta m = \pm 1, \pm 2$ in He and $(F,m) = (1,0) \leftrightarrow (1,-1)$ in H are observed at frequencies of approximately 1570 Mc/s and 1140 Mc/s, respectively. The natural line-shapes for the separated oscillating fields method are obtained with spacings between the oscillating fields of both 4.2 cm and 2.2 cm. The experimental result is $g_J(\text{He},{}^3S_1)/g_J(\text{H},{}^2S_{\frac{1}{2}})\big|_{\text{exp}} = 1 - (23.3 \pm 0.8) \times 10^{-6}$, which agrees with an earlier measurement having an accuracy of 16 p.p.m., and also with the theoretical value $g_J(\text{He},{}^3S_1)/g_J(\text{H},{}^2S_{\frac{1}{2}})\big|_{\text{theor}} = 1 - (23.3 \pm 1.0) \times 10^{-6}$ obtained by Perl and Hughes, which was computed from the Breit equation for He with the addition of a term to represent the interaction of the anomalous spin magnetic moment of each electron with the external magnetic field.

539.18

3960. THE POLARIZATION OF HELIUM-LIKE ATOMS.

A.Dalgarno.

Proc. Phys. Soc., Vol. 72, Pt 5, 889-91 (Nov., 1958).

By using the open-shell (1s,1s') form for the atomic wavefunctions, the polarization caused by a charged particle can be calculated by the exact method of Abstr. 5580 (1957); comparison with the usual power series method shows that the dipole approximation leads to errors usually less than 15%. J.Hawgood

539.18 : 535.37

ON MULTIPLE TRANSITIONS AND THERMAL IONIZATION OF LOCALIZED LEVELS IN THE CONFIGURATIONAL CURVE MODEL. See Abstr. 3309

539.18 : 539.14

ON SOME CORRESPONDENCES BETWEEN ENVELOPAL AND NUCLEAR STRUCTURE OF THE ATOMS. See Abstr. 3809

539.18

3961. ISOTOPE ABUNDANCE DETERMINATIONS OF TITANIUM AND ZIRCONIUM. H.W.Drawin.

Nukleonik, Vol. 1, No. 3, 109-12 (Aug., 1958). In German.

The isotope abundances of Ti and Zr are measured by a simple focusing 60° mass-spectrometer. The ions are produced in a thermionic source. Because of fluctuations of the thermionic emission only double-collector ratio measurements are suitable for accurate determinations. The abundances determined in this way show deviations from earlier measurements of A.O.Nier but agree with more recent measurements of J.E.Hogg (Abstr. 1132/1955). H.London

539.18

3962. ON THE QUESTION OF THE APPROACH TO AN IDEAL ISOTOPE SEPARATION CASCADE BY A STEPPED, TAPERED CASCADE IN THE LOSS-FREE CASE AND WITH CONSIDERATION OF MATERIAL LOSS. H.Barwich.

Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 70-9 (1957). In German.

The approximation to an ideal loss-free cascade by means of a stepped, tapered real cascade gives a minimum of mixture loss if the stage efficiency η is constant at the transition region of one stage size to another. The application of this condition leads to a simple method of calculating the dimensions of the optimum real cascade. For cascades with material loss this method can only be applied if the losses w are less than a critical value w_k. For cascades with $w > w_k$ an approximate method is given. H.C.Cole

539.1

3963. INFLUENCE OF IMPURITIES ON THE ELECTROLYTIC CONCENTRATION OF HEAVY WATER (PRELIMINARY COMMUNICATION). J.Brun, W.Gundersen and T.Varberg.

K. Norske Vidensk. Selsk. Forhandl., Vol. 30, No. 5, 29-34 (1957).

It is shown that the addition of small quantities of certain heavy metal compounds to alkaline electrolyte causes a marked lowering the separation efficiency of iron cathodes for the hydrogen isotopes. The addition of zinc and tin, which increase the overvoltage on the separation, causes a gradual reduction of the separation factor with increasing concentration, e.g. for 1×10^{-6} moles/litre of ZnO the separation factor is 10.8, while at 1×10^{-2} moles/litre of ZnO the separation factor is 6.7. The addition of platinum, chromate and vanadinate, which decrease the overvoltage on separation, causes a lowering of the separation factor, but shows no variation with concentration, e.g. for V_2O_5 the separation factor is 4.0 at 1×10^{-5} moles/litre and at 1×10^{-2} moles/litre. The experimental procedure is briefly described and the effects discussed. H.C.Cole

539.18

3964. THE CASCADING PROBLEM IN A WATER DISTILLATION PLANT FOR HEAVY WATER PRODUCTION.

E.Cerrai, M.Silvestri and S.Villani.

Z. Naturforsch., Vol. 11a, No. 9, 694-701 (1956).

The criteria for designing cascades of minimum specific volume are examined and the theory is generalized to be applicable to the case when the enrichment per stage is large. A practical solution of the cascading problem is also described for the case of a water distillation plant for heavy water production designed to utilize geothermal steam from Larderello (Tuscany). The optimum design for the case where the steam supply is limited is discussed, and the effect of the variation of separation factor along the columns due to pressure drop is taken into account. H.C.Cole

539.18

3965. ENRICHMENT OF URANIUM ISOTOPES BY THE GAS CENTRIFUGE METHOD. W.Groth.

Nukleonik, Vol. 1, No. 2, 68-73 (July, 1958). In German.

The author outlines the history of gas centrifuges constructed in Germany during the war for enrichment of U^{235} in UF_6; he refers to many unpublished material (mostly his own) and gives a detailed description (with illustrations) of a centrifuge working at present in the University of Bonn. Poor yield of previous models (enrichment effect much below theory) was explained by gas convection and eddies caused by local temperature differences; adding hydrogen to gas mixture eliminated these drawbacks and raised the effectiveness much above theory. This latter effect is explained by countercurrent convection within the rotor. Such convection can be produced (also without addition of H_2) in a simple hollow-cylinder centrifuge by insertion of special heating elements. The application of this type of gas centrifuge to the enrichment of U^{235} in UF_6 is described and the results are presented in graphical form. F.Lachman

539.18

3966. MEASUREMENT OF ANGULAR DISTRIBUTION OF SCATTERING WITH CHARGE EXCHANGE OF POSITIVE IONS OF ARGON 40, PALLADIUM 108, AND URANIUM 238 OF 30 keV ENERGY BY ARGON ATOMS. C.Cassignol, F.Daniel, G.Delmas and G.Ranc.

J. Phys. Radium, Vol. 20, No. 1, 20-4 (Jan., 1959). In French.

Description of the method used and of the experimental arrangement and procedure. The results are presented in diagrams.

539.18 : 536.7

THERMODYNAMIC PROPERTIES OF ISOTOPIC MIXTURES. See Abstr. 3409

539.18

3967. NITROGEN—NITROGEN ELASTIC SCATTERING.

C.E.Porter.

Phys. Rev., Vol. 112, No. 5, 1722-30 (Dec. 1, 1958).

An optical-model analysis of the measurements of nitrogen—nitrogen elastic scattering is made, and a quasi-classical discussion of the corresponding phase-shifts is given.

539.18

3968. EXPERIMENTAL RESULTS ON CHARGE-CHANGING COLLISIONS OF HYDROGEN AND HELIUM ATOMS AND IONS AT KINETIC ENERGIES ABOVE 0.2 keV. S.K.Allison.

Rev. mod. Phys., Vol. 30, No. 4, 1137-68 (Oct., 1958).

A comprehensive review listing 117 references. A brief mathematical description of charge exchange involving two and three component systems is followed by an account of methods of measurements of fractions of components and cross-sections. Experimental data on hydrogen and helium ionic and atomic beams in various gases and in solids are presented and discussed.

C.G.Morgan

539.18 : 535.332

3969. LIGHT EXCITATION IN THE BOMBARDMENT OF HELIUM WITH LIGHT AND HEAVY HYDROGEN.

W.Hanle and G.A.Voss.

Z. Naturforsch., Vol. 11a, No. 10, 857-62 (1956). In German.

The triplet lines of helium were excited by bombarding the gas with H^+, D^+, T^+ ions; with D^+ and T^+ the Balmer series of neutral hydrogen was excited too. The excitation function (light intensity/ ionic current × gas density) of the He lines, 3889 A and 5876 A, and of the H_α line increased slowly and uniformly with the energy (2-20 kV) of the bombarding ions. The excitation functions for helium bombarded with hydrogen and deuterium ions were the same, as were those for hydrogen and deuterium bombarded with helium ions.

B.T.M.Willis

MOLECULES

539.19

3970. APPLICATIONS OF QUANTUM MECHANICS IN THEORETICAL CHEMISTRY. G.G.Hall.

Rep. Progr. Phys., Vol. 22, 1-32 (1959).

Progress in the application of quantum mechanics to study the electronic structure of molecules has, until recently, been disappointing and slow. Many difficulties, both of mathematical method and of numerical analysis, arise when there is a large number of particles in the quantum mechanical system. In this review the different ways of applying quantum mechanics to chemical problems are discussed. The accuracy expected and attained by each method is illustrated, but applications to individual molecules are not reviewed. The coming of electronic computers has already produced great changes in this subject. In particular, it is now possible to calculate highly accurate wave-functions from first principles for a range of molecules. Direct calculations of this kind are not possible for large molecules and, for these, the problem has been to find suitable parameters which remain constant for a series of molecules and can be used to describe their properties. This problem is intimately connected with the problem of interpreting quantum-mechanical calculations in a chemically significant way. Quantum mechanics can also be applied to molecules by setting up models which simplify the quantum mechanical equations but retain those features which are most significant for a series of related molecules. Finally, some of the objectives of current research are briefly reviewed. The wider significance of the subject and its importance for chemistry and the theories of the solid state and the nucleus are also discussed.

539.19

3971. ON WU–YANG POTENTIAL ENERGY FUNCTION.

Y.P.Varshni.

Proc. Phys. Soc., Vol. 73, Pt 1, 119-21 (Jan.,1959).

Using the potential energy function proposed by Wu and Yang (Abstr. 1000/1945) the calculated results obtained are not in agreement with observed data on diatomic molecules and a large error in the force constant is also obtained.

G.I.W.Llewelyn

539.19

3972. COEFFICIENTS OF INTERACTION BETWEEN VIBRATION AND ROTATION IN POLYATOMIC MOLECULES. I.

G.Amat and L.Henry.

Cahiers de Phys., Vol. 12, 273-86 (July, 1958). In French.

Orthogonality relations are established between the interaction coefficients $a^{\alpha\beta}_{s\sigma}$, $A^{\alpha\beta}_{s\sigma s'\sigma'}$, $\zeta^{\alpha}_{s\sigma s'\sigma'}$. These enable the coefficients to be computed more easily and show that the rotation–vibration Hamiltonian does not depend upon the $A^{\alpha\beta}_{s\sigma s'\sigma'}$ coefficients.

539.19

3973. ROTATIONAL VIBRATIONAL ENERGY OF PLANE SYMMETRICAL MOLECULE $X_2Y_2Z_2$. O.Hálová.

Czech. J. Phys., Vol. 8, No. 4, 471-84 (1958).

The energy is calculated to the second approximation, taking into account the anharmonic terms of third and fourth order in the potential function, Coriolis interaction of rotation and vibration, centrifugal effects and the dependence of the rotational constants on the state of vibration.

539.19

3974. TORSIONAL FREQUENCIES OF 1,2-DIHALOGENETHANES.

I.Ichishima, H.Kamiyama, T.Shimanouchi and S.Mizushima.

J. chem. Phys., Vol. 29, No. 5, 1190-1 (Nov., 1958).

Far infrared spectra of 1,2-dihalogenethanes in liquid and gaseous states, obtained with a grating spectrometer, have given new data on the torsional vibrations of the transform. The height of the barrier to internal rotation is 4.7 kcal/mole.

R.C.Seymour

539.19

3975. INFRARED ABSORPTION ASSOCIATED WITH STRONG HYDROGEN BONDS. N.Albert and R.M.Badger.

J. chem. Phys., Vol. 29, No. 5, 1193-4 (Nov., 1958).

The existence of a correlation between the O–O distance in O–H–O bonds and the shift of O–H vibrational frequency is disputed in the case of crystalline substances containing short hydrogen bonds. In potassium hydrogen phenylacetate and acetamide hemihydrochloride, no bands for O–H vibrations were found at frequencies predicted by such correlations but there was intense background absorption in the region 600-1600 cm^{-1}. Comparison of apparent integral extinction coefficients of acetamide and its hemihydrochloride in this region suggests that frequencies of two or more of the three proton vibrations are nearly coincident.

R.C.Seymour

539.19

3976. ASSIGNMENT OF THE FUNDAMENTAL VIBRATIONAL FREQUENCIES AND CALCULATED THERMODYNAMIC FUNCTIONS FOR 1,1-DIFLUORO-2, 2-DIBROMOETHYLENE.

J.R.Nielsen and R.Theimer.

J. chem. Phys., Vol. 30, No. 1, 103-4 (Jan., 1959).

The previous assignment of the fundamental vibrational frequencies of the $CF_2 : CBr_2$ molecule is revised in the light of the results of a recent normal coordinate analysis by Mann et al. and other evidence. The revised assignment is as follows: species a_1: 1718, 1005, 598, 324, 168; species: b_1: 1037, 898, 399, 151; species b_2: 572, 303; species a_2: 151 cm^{-1}. All but the two lowest wave-numbers are for the gaseous state. Thermodynamic functions are recalculated for the ideal gaseous state at 1 atm. pressure for four temperatures above the boiling point.

539.19

3977. TRIATOMIC LINEAR MOLECULES CONTAINING CARBON AND OXYGEN, SULFUR, SELENIUM, OR TELLURIUM.

II. POTENTIAL CONSTANTS. T.Wentink, Jr.

J. chem. Phys., Vol. 30, No. 1, 105-15 (Jan., 1959).

For Pt I see Abstr. 1821 (1959). The fundamental vibrational frequencies for CO_2, CS_2, CSe_2, OCS, OCSe, SCSe, and SCTe are used in a uniform analysis based on the valence force field to evaluate the force constants. The extensive literature on CO_2, OCS, and CS_2 is reviewed since a choice of frequencies is necessary due to significant divergence of some earlier data. The stretching interaction constants are used to test the validity of a theoretical expression for calculating such an interaction. A compilation of the best values of the internuclear distances in this family is also presented. The main stretching force constant and the bond distance for a given bond (e.g. C=O) may be transferred from molecule to molecule to a high degree of approximation. The force constants, in 10^5 dyne/cm, for the bonds C=O, C=S, C=Se, and C=Te are, respectively: 15.96 ± 0.04, 7.62 ± 0.20, 5.79 ± 0.16, and 4.58. The interaction constants, for the molecules in the same order and the same units are 1.262, 0.661, 0.36, 0.97, 0.85, 0.53, and 0.30.

539.19

3978. BENDING MOTIONS IN THE DIHALIDES OF GROUP II METALS. R.S.Berry.

J. chem. Phys., Vol. 30, No. 1, 286-90 (Jan., 1959).

A polarizable ion model is used to calculate the force constants for bending in the dihalides of the second-group metals. The results indicate that the bending constant is a sensitive function of the polarizability of the metal. The calculated constants are in moderate agreement with the experimental values. Some of the implicit assumptions of the model are discussed together with the implications of the calculated results.

539.19

3979. VIBRATIONAL INTENSITIES. XI. CO_2 AND THE WILSON–WELLS METHOD.

J.Overend, M.J.Youngquist, E.C.Curtis and B.Crawford, Jr.

J. chem. Phys., Vol. 30, No. 2, 532-7 (Feb., 1959).

For Pt X, see Abstr. 1824 (1959). The Wilson—Wells—Penner—Weber method of determining absorption-band intensities in the infra-red is critically reviewed. This technique is used to redetermine the intensity of the 670 cm^{-1} band system of carbon dioxide. The present result, A = 241 cm^{-1}/cm atm at S.T.P. agrees well with the curve-of-growth value, A = 240 cm^{-1}/cm atm at S.T.P. and demonstrates that, with proper precautions, both methods are capable of producing reliable intensity data.

539.19

3980. THE SPINS OF IONS OF THE TRANSITION METALS IN THEIR OCTAHEDRAL COMPLEX COMPOUNDS. H.Hartmann.
Z. Naturforsch., Vol. 11a, No. 10, 884-5 (1956). In German.

Tables of predicted ground states and of observed multiplicities are given. R.F.Barrow

539.19 : 535.343

FAR INFRARED SPECTRUM AND THE BARRIER TO INTERNAL ROTATION IN 1,1,1,2-TETRAFLUOROETHANE. See Abstr. 3296

539.19

3981. DISSOCIATION OF THE HYDROGEN MOLECULE ION BY ELECTRON IMPACT. E.V.Ivash.
Phys. Rev., Vol. 112, No. 1, 155-8 (Oct. 1, 1958).

The dissociation cross-section of H_2^+ for bombardment by electrons is investigated taking into account the effect of exchange collisions by use of the Born—Oppenheimer approximation. Both the post and prior interactions are considered. Theoretical results are presented for the transition in which the molecule ion is raised from the ground state 1sσ $^2\Sigma_g^+$ to the lowest lying repulsive state 2pσ $^2\Sigma_g^+$ and then dissociates. The Franck—Condon principle is assumed throughout, and a classical average is taken over the molecular orientations. Numerical results are given for the dissociation cross-sections as a function of energy both with and without the inclusion of exchange effect. The agreement between the post- and prior-interaction cross-sections near the threshold energy is poor.

539.19 : 537.533 : 539.18

MEASUREMENT OF ATOMIC AND MOLECULAR EXCITATION BY A TRAPPED-ELECTRON METHOD. See Abstr. 3958

539.19

3982. ON DETECTION OF TRIPLET MOLECULES IN SOLUTION BY ELECTRON SPIN RESONANCE. S.I.Weissman.
J. chem. Phys., Vol. 29, No. 5, 1189-90 (Nov., 1958).

The measurements of Hutchison and Magnum on electron spin resonance of photoexcited naphthalene in single crystals demonstrate that there is a dipolar coupling between the unpaired electrons in the triplet state which is large enough to render observations of resonance in earlier experiments very difficult, because in both rigid and fluid solvents the line width would be very large.

J.M.Baker

539.19

3983. INTERPRETATION OF THE ELECTRON-SPIN RESONANCE SPECTRUM OF THE METHYL RADICAL. M.Karplus.
J. chem. Phys., Vol. 30, No. 1, 15-18 (Jan., 1959).

A valence-bond calculation of the proton hyperfine splitting in the electron-spin resonance spectrum of the methyl radical was performed. The splitting was computed as a function of the angular configuration of the molecule. For the planar radical a splitting of 27 ± 5 gauss was found, in agreement with experimental measurements on irradiated solids. However, the functional dependence of the splitting on angular configuration and the uncertainty in certain of the molecular integrals are such that deviations from planarity of 10-15° cannot be definitely excluded.

539.19

3984. NUCLEAR MAGNETIC RESONANCE OF PROTON DILUTE SILICA GEL AND SILICA ALUMINAS.
D.E.O'Reilly, H.P.Leftin and W.K.Hall.
J. chem. Phys., Vol. 29, No. 4, 970-1 (Oct., 1958).

Proton magnetic resonance is used to study the concentration and state of protons in silica aluminas and silica gels dehydrated at 500°C. Concentrations are of order 10^{21} protons per gramme. T_2's are of order 10^{-4} secs and are constant over the range −210° to +280°C. Chemical shift measurements suggest the protons are mainly in Si-OH groups. The distribution of the protons over the lattice sites is discussed. J.G.Powles

539.19 : 538.69 : 538.27

3985. PROTON MAGNETIC RESONANCE IN POLYISOBUTYLENE AT VARIOUS TEMPERATURES, PRESSURES, AND FREQUENCIES.
A.W.Nolle and J.J.Billings.
J. chem. Phys., Vol. 30, No. 1, 84-90 (Jan., 1959).

New experimental data are reported for the effects of pressures up to 1060 kg/cm^2 on the hydrogen nuclear magnetic resonance line width for polyisobutylene, at various temperatures from −100°C to 32°C. The spin—lattice relaxation time is measured at room temperature for frequencies from 1.9 to 39 Mc/s, in which range it varies approximately as the first power of the frequency, and is als investigated as a function of pressure at fixed frequency. Pressure effects on the line-width are discussed in terms of an activation energy dependent on the volume. The frequency dependence of the relaxation time indicates, but does not completely determine, a distribution of thermal motion correlation times. The effects of three hypothetical distributions are computed.

539.19

3986. THE NON-EMPIRICAL CALCULATION OF THE FORCE CONSTANT OF THE MOLECULE LiH. G.Bessis and S.Bratož.
C.R. Acad. Sci. (Paris), Vol. 247, No. 23, 2121-3 (Dec. 10, 1958).
In French.

This has been carefully re-calculated from the SCF and configuration interaction wave-functions of Karo and Olson (1956), usin an eighth degree interpolation polynomial both on the individual molecular integrals and on the total electronic energy. The SCF result is the better, and the atom-core contribution is predominan over that of the valence electrons. J.Hawgoo

539.19

3987. ELECTRONIC DISTRIBUTION IN SOME CONJUGATED KETONES. MOLECULAR ORBITAL CALCULATIONS INCLUDING OVERLAP. G.Payette and C.Sandorfy.
J. chem. Phys., Vol. 30, No. 1, 168-74 (Jan., 1959).

Electronic charge distributions in 8 conjugated ketones were computed by the semiempirical molecular orbital method in Wheland's approximation, including overlap between adjacent atoms. It is found that inclusion of overlap leads to a clearer picture of charge distribution. It is shown that covalent and ionic contributions to bond energies may decrease or increase at the same time upon excitation, or a structural change in the π system. A new "Coulomb bond order" is defined, giving a measure of bond energies in terms of Coulombic interactions between local charges.

539.19

3988. FURTHER CONSIDERATIONS OF A PREVIOUS LCAO-MO STUDY OF THE ALLYLIC-TYPE TRANSITION STATE IN 1,3-BUTADIENE. F.L.Pilar.
J. chem. Phys., Vol. 30, No. 2, 375-8 (Feb., 1959).

For previous work see Abstr. 1837 (1959). Approximate solution are obtained for the molecular orbital energies of a perturbed allylic-type transition state involved in the ionic addition reactions of 1,3-butadiene. It is shown that consideration of the perturbation effects on either or both the Coulombic and resonance integrals leads to a correct prediction of chemical reactivity based on the criteria of atom stabilization energies, frontier electron densities, and total electron densities.

539.19

3989: SOME OBSERVATIONS ON THE "SELF CONSISTENT FIELD" PROCEDURE AND ON THE METHOD OF CONFIGURATIONAL INTERACTION IN THE QUANTUM THEORY. H.Preuss.
Z. Naturforsch., Vol. 11a, No. 10, 823-31 (1956). In German.

It is shown to be possible in the use of the self consistent field method to obtain, without change in the mathematical form of the method, better one electron molecule functions than are obtained by linear combination of atomic functions. In the method of configurational interaction the application of two-centre functions is discussed and the resulting integrals given. The interaction integral appears in much simpler form than those hitherto applied. The application of Gaussian functions gives simple integrals and by such an application the energy of the hydrogen atom in the ground state is calculated to within 3%. W.Good

539.19

3990. STRUCTURES OF DIMETHYL ETHER AND METHYL ALCOHOL. K.Kimura and M.Kubo.
J. chem. Phys., Vol. 30, No. 1, 151-8 (Jan., 1959).

The molecular structures of dimethyl ether and methyl alcohol were determined in gaseous state by means of the sector-microphotometer method in electron diffraction. The structural information was derived from the resolution of radial distribution curves. It was confirmed that a dimethyl ether molecule exerts hindered internal rotation with a potential minimum at the C_{2v} configuration. The most probable values for the bond distances and the bond angle are for dimethyl ether: C—O = 1.416 ± 0.003 A, C—H = 1.094 ± ± 0.006 A, $\angle$COC = 111.5° ± 1.5°; and for methyl alcohol: C—O = = 1.428 ± 0.003 A, C—H = 1.095 ± 0.010 A, O—H = 0.960 ± 0.015 A, $\angle$COH = 109° ± 3°. The results on methyl alcohol agree with those of microwave determinations. The observed values of vibrational amplitudes are in good agreement with those computed theoretically.

539.19

3991. ON THE DIELECTRIC CONSTANT OF MOLECULES CONTAINING HYDROGEN BONDS. S.Bratož.

C.R. Acad. Sci. (Paris), Vol. 247, No. 22, 1968-70 (Dec. 1, 1958). In French.

Theoretical discussion shows that unless the energy barrier between the alternative asymmetrical positions of the proton is very low, the dipole moment will be that given by assuming the proton fixed in one position. Departure from the Langevin–Debye formula for the dielectric constant may be expected for low barriers or low temperatures. J.Hawgood

539.19 : 535.343

VIBRATIONAL SPECTRA AND STRUCTURE OF OXAMIDE AND DITHIOOXAMIDE. See Abstr. 3295

539.19 : 535.343

MICROWAVE SPECTRUM, STRUCTURE, AND DIPOLE MOMENT OF CYCLOPROPENE. See Abstr. 3300

539.19

3992. DIPOLE MOMENTS OF SOME SUBSTITUTED BENZENES AND PYRIDINES. C.R.K.Murty.

Indian J. Phys., Vol. 32, No. 11, 516-20 (Nov., 1958).

The dipole moments of seven substituted pyridines have been determinated in dilute solution in benzene. The moment values are also calculated using group moments and vectorial method. The differences in moments between the calculated and observed values have been discussed.

539.19

3993. STATISTICAL MECHANICS OF HELIX-COIL TRANSITIONS IN BIOLOGICAL MACROMOLECULES.

J.H.Gibbs and E.A.DiMarzio.

J. chem. Phys., Vol. 30, No. 1, 271-82 (Jan., 1959).

The polypeptide backbone, common to the macromolecular chains of proteins, represents a highly cooperative system which is essentially one dimensional and, therefore, tractable theoretically. The complete partition function for such a system can be evaluated with the aid of either the method of Lagrangian multipliers or the method of steepest descents. When this is done a transition from alpha helix to random coil is obtained as a result. When the effects of solvation are included, the transition may or may not be inverted depending upon the nature of the solvent. The quantitative theoretical results for dilute solutions are in agreement with the available experimental data on the reversible "denaturation" of synthetic polypeptides. The separation of the two strands of the double-stranded helix of the genetic material, desoxyribonucleic acid, can be treated with the same theoretical method.

539.19

3994. GENERALIZATION OF THE ONE-DIMENSIONAL ISING MODEL APPLICABLE TO HELIX TRANSITIONS IN NUCLEIC ACIDS AND PROTEINS. T.L.Hill.

J. chem. Phys., Vol. 30, No. 2, 383-7 (Feb., 1959).

The exact treatment of the Ising model for an infinite, one-dimensional system is generalized to make it applicable to the helix transition in synthetic polynucleotides, DNA, synthetic polypeptides, and proteins. The particular advantages of the treatment are flexibility and generality: the free energies of sequences of similar units of any size can be assigned arbitrary values in the final equations; also "mismatching" between the two strands in a double helix is allowed for.

539.19 : 535.343

SPECTROSCOPIC DETERMINATION OF THE ABSOLUTE BOND MOMENT OF THE CH BOND IN LONG HYDROCARBON CHAINS. See Abstr. 3297

539.19

3995. ELECTRON-BOMBARDMENT DETECTION OF NONCONDENSABLE MOLECULAR BEAMS.

W.E.Quinn, A.Pery, J.M.Baker, H.R.Lewis, N.F.Ramsey and J.T.LaTourrette.

Rev. sci. Instrum., Vol. 29, No. 11, 935-43 (Nov., 1958).

An electron-bombardment detector developed for the detection of noncondensable as well as condensable molecular beams is described. The ionization efficiency for a hydrogen deuteride beam is in the range of 10^{-5} to 10^{-4}. Auxiliary components include: vacuum buffer chambers for source background gas reduction; a mass spectrometer for ion mass selection; an electron multiplier, electrometer, and phase-sensitive detector combination for signal observation. Modulation techniques for beam and magnetic resonance detection are discussed. Efficiencies, background problems, and relevant noise sources are included in a discussion of operational characteristics. A resonance line trace produced by at most 3% of a total HD beam is presented to demonstrate the signal to noise ratio at low signal levels. The system has effectively detected beams of permanent gases such as HD, D_2, and Ne.

539.19 : 535.343

3996. RADIO-FREQUENCY SPECTRA OF HYDROGEN DEUTERIDE IN STRONG MAGNETIC FIELDS.

W.E.Quinn, J.M.Baker, J.T.LaTourrette and N.F.Ramsey.

Phys. Rev., Vol. 112, No. 6, 1929-40 (Dec. 15, 1958).

See preceding abstract. Molecular beam observations were made of the radiofrequency spectra corresponding to reorientations of the deuteron, proton, and rotational magnetic moments in the HD molecule. For HD in the zero vibrational and first rotational state, these observations were made in magnetic fields of approximately 1700, 3400, and 4800 gauss. The results are found to be consistent with the theory of heteronuclear diatomic molecules. The direct result of these experiments is the determination of the Hamiltonian interaction constants: $(1-\sigma_{J_1})b/\nu_d = 0.773527 \pm 0.000016$, C_p is $85\,600 \pm 18$ c/s, $C_d = 13\,122 \pm 11$ c/s, d_1 is $17\,761 \pm 12$ c/s, $d_2 = 22\,454 \pm 6$ c/s, and f/H^2 is $(-26.90 \pm 0.40) \times 10^{-6}$ c/s gauss^{-2}. From these values of the interaction constants are derived the following physical quantities: the HD rotational magnetic moment $HD_0\langle\mu_J/J\rangle_1 = 0.663211 \pm 0.000014$ nuclear magneton, the quadrupole moment Q of the deuteron is $(2.738 \pm 0.014) \times 10^{-27}$ cm^2, the rotational magnetic field H_p' at the proton is 19.879 ± 0.006 gauss and H_d' at the deuteron is 20.020 ± 0.028 gauss, the internuclear spacing in the zeroth vibrational and first rotational state is such that $HD_0\langle R^{-3}\rangle_1^{-\frac{1}{3}} = (0.74604 \pm 0.00010) \times 10^{-8}$ cm, and the dependence of the diamagnetic susceptibility on molecular orientation $(\xi_{\pm 1} - \xi_0)$ is $-(3.56 \pm 0.20) \times 10^{-31}$ erg gauss^{-2} molecule^{-1}. Combining these values with Ramsey's theory on zero-point vibration and centrifugal stretching in molecules gives the high-frequency contribution to the molecular susceptibility, $HD_0\langle\xi hf\rangle_1 = (1.675 \pm 0.005) \times 10^{-31}$ erg gauss^{-2} molecule^{-1}; the quadrupole moment of the electron distribution relative to the internuclear axis, $HD_0\langle Q_e\rangle_1 = (0.324 \pm 0.010) \times 10^{-16}$ cm^2; and the high-frequency contribution to the magnetic shielding constant for HD,

$$HD_0\langle\sigma hf\rangle_1 = (-0.594 \pm 0.030) \times 10^{-5}.$$

539.19

3997. VARIATION OF VOLUME OF LOCALIZATION OF ELECTRONS AND DISPLACEMENT BY COLLISION IN ELECTRONIC TRANSITIONS. F.Schuller and R.Bergeon.

C.R. Acad. Sci. (Paris), Vol. 247, No. 23, 2113-16 (Dec. 10, 1958). In French.

Pressure displacement of absorption lines is discussed by means of a perturbation analysis of a model in which the atom which is undergoing an electronic transition is simultaneously perturbed by one other atom confined with it in a box. It is shown that the displacement may be either to higher or lower frequencies, as has been found experimentally but not by previous theories. J.Hawgood

539.19 : 535.343

3998. CRITICAL ANALYSIS AND APPLICATIONS OF A QUASI-RESONANT THEORY OF PRESSURE BROADENING OF LINEAR MOLECULES. L.J.Kieffer and A.V.Bushkovitch.

J. molecular Spectrosc., Vol. 2, No. 6, 558-65 (Dec., 1958).

A simplified Anderson theory of the pressure broadening of linear molecules is critically analysed and applied to five common types of molecular interactions. It is shown that the simplified theory is equivalent to assuming that all partial cross-sections of the exact Anderson theory are of the same order of magnitude as the resonant partial cross-sections. Quantitative estimates of the errors introduced in the partial cross-sections of the exact theory by making this simplifying assumption are given.

539.19

3999. VIBRATIONAL TRANSITION IN MOLECULAR COLLISION. II. INFLUENCE OF THE VAN DER WAALS FORCE. K.Takayanagi.

Sci. Rep. Saitama Univ. A, Vol. 3, No. 1, 1-19 (1958).

Vibrational transition in nitrogen gas is considered, the main purpose being to investigate the influence of the Van der Waals force on the transition probability. This force gives rise to the negative part of the potential curve and also affects the slope of the repulsive part of the potential. It is found that the depth of the potential valley has no great influence directly on the transition probability, while the slope of the repulsive part plays the leading role in determining the probability. Transition probability is also calculated for chlorine gas. In both cases, the resulting probabilities are compared with the experimental values. The Van der Waals force may also be the direct cause of the vibrational transitions. A modified Born approximation is used to estimate this direct effect. It is inferred that the effect is not very great, although it may not be negligible in the quantitative calculations.

539.19 : 537.563

PHOTODETACHMENT OF O_2^-. See Abstr. 3607

SOLID-STATE PHYSICS

539.2 : 536.413

4000. PROPERTIES OF SOLID ARGON.
E.R.Dobbs, B.F.Figgins and G.O.Jones.
Nuovo Cimento Suppl., Vol. 9, No. 1, 32-5 (1958).

The expansivity is found to be twice the previously assumed value, and an anomalously high value of C_p (Clusius, Abstr. 2275/1936) is accounted for. The interatomic potential is found to be in good agreement with that of Domb and Zucker (Abstr. 2457/1957).
P.Gray

539.2 : 536.71

4001. THE EQUATION OF STATE OF SOLID HELIUM.
J.S.Dugdale.
Nuovo Cimento Suppl., Vol. 9, No. 1, 27-31 (1958).

This is derived from the 4.2°K isothermal, using the Lindemann melting formula and the Debye—Grüneisen model. The melting curve and the lattice energy (against molar volume) are presented graphically, and a table of Debye and melting temperatures, and Grüneisen γ, for several volumes is given.
P.Gray

539.2 : 537.311.33

4002. COMPRESSIBILITY AND PRESSURE DISPLACEMENT OF THE ABSORPTION CONSTANT OF CADMIUM SULPHIDE.
E.Gutsche.
Naturwissenschaften, Vol. 45, No. 20, 486 (1958). In German.

Summarizes measurements of linear compressibility, pressure dependence of absorption constant, spectral distribution of photoconductivity, and width of forbidden band of high purity CdS single crystals. Fuller publication is in preparation.
G.C.Williams

539.2

4003. MANY-BODY PROBLEM WITH ONE-BODY FORCES.
J.S.Bell.
Proc. Phys. Soc., Vol. 73, Pt 1, 118-19 (Jan., 1959).

In a model consisting of one scattering centre in a Fermi gas, present approximation methods lead to a spurious singularity just below the Fermi surface. It is contended that similar singularities found in a system with two-body interactions may be equally spurious.
J.C.Taylor

539.2 : 537.312.8

FERMI SURFACE OF ALKALI METALS. See Abstr. 3513

539.2

4004. USE OF THE FOURIER TRANSFORM IN THE STUDY OF SINGULARITIES IN THE FREQUENCY SPECTRUM OF A CRYSTAL.
A.Maradudin and J.Peretti.
C.R. Acad. Sci. (Paris), Vol. 247, No. 25, 2310-11 (Dec. 22, 1958).
In French.

539.2 : 548.732

4005. APPROXIMATE ELASTIC SPECTRUM OF β-AuZn FROM TEMPERATURE DIFFUSE SCATTERING OF X-RAYS.
M.Schwartz and L.Muldawer.
J. appl. Phys., Vol. 29, No. 11, 1561-8 (Nov., 1958).

The temperature diffuse scattering of X-rays from a single crystal of β-AuZn was measured at room temperature using a Geiger counter diffractometer and crystal monochromatic CuK_α radiation. Acoustical frequency and velocity dispersion curves were obtained for the symmetry axes using the theories of James and Laval. Integrated intensity measurements of Bragg reflections from the alloy gave Debye temperatures of 153°K and 220°K for gold and zinc, respectively. The velocities at infinite wavelengths yielded elastic constants of $c_{11} = 5.3$, $c_{12} = 3.5$, and $c_{44} = 3.0$ in units of 10^{11} dynes per cm. An approximate frequency spectrum was calculated.

539.2

4006. THERMAL AGITATION OF ATOMS IN A CRYSTALLINE MEDIUM. I. J.Laval.
J. Phys. Radium, Vol. 20, No. 1, 1-6 (Jan., 1959). In French.

Thermal agitation produces interatomic forces which are not in accordance with Hooke's law and they cannot be analysed into independent harmonic oscillations, which are 3n in number in a crystal composed of n atoms. Nevertheless, it can be resolved into harmonic components which include fundamental oscillations, to the number of 3n, and secondary oscillations which in the broad sense are the harmonics of fundamental oscillations. Fundamental and secondary oscillations develop forces sensibly constant in course of time, which constitute thermal strains.

539.2 : 536.631

4007. THE VIBRATIONAL SPECTRUM AND SPECIFIC HEAT OF GERMANIUM. F.A.Johnson and J.M.Lock.
Proc. Phys. Soc., Vol. 72, Pt 5, 914-17 (Nov., 1958).

Values for atomic heat calculated from the lattice vibration spectrum show excellent agreement with the experimentally determined specific heat at temperatures between 1°K and 400°K.
C.Hilsum

539.2

4008 TRANSPORT IN METALS: EFFECT OF THE NON-EQUILIBRIUM PHONONS. M.Bailyn.
Phys. Rev., Vol. 112, No. 5, 1587-98 (Dec. 1, 1958).

The coupled Boltzmann equations for phonons and electrons in a metal are solved simultaneously using first-order perturbation theory. Use is made of the Kohler variational principle to put the transport coefficients in terms of determinants. The final results are in the form of integrals involving the phonon-phonon relaxation time $\tau(\sigma)$ and the electron-electron relaxation time. The details of how a finite electrical conductivity exists by means of umklapp processes even when $\tau(\sigma) \to \infty$ (the Peierls equilibrium problem) is revealed in the electrical conductivity expression. In general, the effects may be described as "phonon relaxation" effects, altering all the transport coefficients somewhat when $\tau(\sigma)$ gets large, and "phonon-drag" or drift effects, altering appreciably only the thermoelectric power.

539.2

4009. ELECTRON SPECTRA OF CRYSTALS. F.Stöckmann.
Naturwissenschaften, Vol. 45, No. 21, 502-6 (1958). In German.

Absorption spectra for radiation of wavelength from 100 mμ upwards (i.e. energies up to 12.3 eV) are used as an indication of the spectra of electron energies. The spectra of rubidium halides, Cu_2O, Ge and a cyanin dye are given.
A.R.Stokes

539.2

4010. ELECTRON SPECTRA IN CRYSTALS. F.Stöckmann.
Naturwissenschaften, Vol. 45, No. 22, 532-7 (1958). In German.

See preceding abstract. Spectra of alkali halide and Ge crystals with imperfections are reproduced, and the effect of the thermal motion of the crystal lattice is considered. There are 43 references.
A.R.Stokes

539.2

4011. LORENTZIAN GAS AND HOT ELECTRONS. I.Adawi.
Phys. Rev., Vol. 112, No. 5, 1567-70 (Dec. 1, 1958).

The problem of hot electrons in a nonpolar crystal is reconsidered using the Lorentzian gas model more accurately. Scattering by acoustical phonons alone is considered first. The new results are (1) an asymptotic formula for the moments of the velocity distribution which permits calculation of the deviation from the square root law at high fields, and (2) a recursion system allowing the calculation of any velocity polynomial in terms of the average energy, random velocity, and mobility of the electrons. Scattering by ionized impurities in addition to acoustical phonons is considered next and the distribution function is derived. The proportionality constant relating the change in the low-field mobility to E^2 is shown to be highly sensitive to ionized impurity scattering. Thus, appreciable changes from its value for pure lattice scattering occur for μ_0/μ_I as low as 10^{-3}. (E is the field strength and μ_0 and μ_I are the low-field lattice and impurities mobilities, respectively). It is pointed out that substantial deviations from results obtained using a Maxwellian distribution do occur.

539.2

4012. ORBITAL CONSTRUCTIONS AND ELECTRON POPULATIONS IN THE TRANSITION ELEMENTS. W.R.Trost.
Canad. J. Chem., Vol. 37, No. 2, 460-74 (Feb., 1959).

Orbital constructions and electron populations for the bands in the transition elements have been worked out. With the assumption of uniform density of states in delocalized bands among nearest neighbours, it is possible to predict correctly the lattice elected by the elements. Manganese and iron are exceptions. Numerical values for electron populations in the several s, p, d, and hybrid bands, including their bonding, antibonding, and non-bonding levels, are obtained.

539.2

4013. DISPERSION THEORY FOR ELECTRONS IN A RANDOM LATTICE WITH APPLICATIONS TO THE ELECTRONIC STRUCTURE OF ALLOYS. J.Korringa.

J. Phys. Chem. Solids, Vol. 7, No. 2-3, 252-8 (Nov., 1958).

In a three dimensional atomic lattice, occupied at random by atoms of more than one kind, a complete set of approximate solutions of the one-electron Schrödinger equation is obtained that have the periodicity of a Bloch wave in the average. Equations are given that permit the calculation of their energies, their average behaviour, apart from a phase factor, near an atom of any type, and of a damping parameter for each wave. A correspondence is established between a random A–B lattice and a periodic lattice with a complex, energy dependent, potential. The eigenvalue problem in this potential, which can be solved with any of the known methods for a periodic potential, yields the dispersion relation of the system.

539.2

4014. INFRARED MEASUREMENTS ON THE TEMPERATURE DEPENDENCE OF THE ELECTRON ACTIVATION ENERGY IN TRIVALENT [METAL] TELLURIDES. G.Harbeke and G.Lautz.

Optik, Vol. 14, No. 12, 547-54 (Dec., 1957). In German.

The optical width of the forbidden zone in the band model has been derived from absorption measurements on Ga_2Te_3 and In_2Te_3 crystals. The variation of the gap width with temperature was found to be linear down to about 350°K, below which temperature the changes were slower and non-linear. Comparisons with theoretical predictions and with the energy gaps found from conductivity and photoconductivity measurements are made. K.W.Plessner

539.2 : 537.311.62

4015. THEORY OF CYCLOTRON RESONANCE IN METALS. S.Rodriguez.

Phys. Rev., Vol. 112, No. 5, 1616-20 (Dec. 1, 1958).

The surface impedance of a metal, in the extreme anomalous skin effect region and in the presence of a magnetic field H_0 parallel to its surface, is calculated assuming specular reflection and spherical energy bands. The surface impedance is given in the cases in which the microwave electric field is parallel and at right angles with H_0, longitudinal and transverse, respectively. The position, intensities, and width of the cyclotron resonance lines are the same for longitudinal and transverse cyclotron resonance.

539.2 : 535.371

ELECTRONIC PROCESSES IN THE LUMINESCENCE OF IONIC CRYSTALS. See Abstr. 3313

539.2

4016. CAVITY FORMATION IN NITRATE-DOPED ALKALI HALIDES. S.Amelinckx, W.Maenhout-Van der Vorst and W.Dekeyser.

Acta metallurgica, Vol. 7, No. 1, 8-17 (Jan., 1959).

Cavities filled with a gaseous product were formed in nitrate-doped alkali halide crystals after anneal in a hydrogen atmosphere. These experiments show that the gaseous products of a chemical reaction in a solid, precipitate along dislocations if enough activation is present to allow diffusion. Diffusion is facilitated by the formation of small agglomerates consisting of a few gas molecules and a number of vacancies.

539.2

4017. PRECIPITATION ON A DISLOCATION. R.Bullough, R.C.Newman, J.Wakefield and J.B.Willis.

Nature (London), Vol. 183, 34-5 (Jan. 3, 1959).

Transmission infrared microscopy showed that heat treatment of silicon crystals containing up to 10^{17} aluminium atoms/cm^3 caused precipitation of a second phase within the crystals. In samples free of dislocations these precipitates were needle-shaped and located at random sites, whereas in crystals with 10^3-10^4 dislocations/cm^2 precipitation occurred along dislocation lines. Possible mechanisms of precipitate growth are discussed. B.T.M.Willis

539.2 : 536.4

4018. THERMAL EXPANSION AND MELTING OF SIMPLE METALS. G.Borelius.

Nuovo Cimento Suppl., Vol. 9, No. 1, 36-8 (1958).

These processes are due to growth of lattice defects (order–disorder transformations of first order) in close packed cubic structures, while discontinuous changes in basic structure at melting also take place with more complex lattices. P.Gray

539.2

4019. DISLOCATION VELOCITIES, DISLOCATION DENSITIES, AND PLASTIC FLOW IN LITHIUM FLUORIDE CRYSTALS. W.G.Johnston and J.J.Gilman.

J. appl. Phys., Vol. 30, No. 2, 129-44 (Feb., 1959).

Velocities of individual dislocations have been measured in LiF, covering a range of twelve orders of magnitude in velocity, from 10^{-7} to 10^5 cm/sec. The velocity is extremely sensitive to applied stress at low velocities, and for each crystal there exists a minimum stress for dislocation motion, below which dislocations do not move. The edge components of dislocation loops move considerably faster than the screw components. The upper limit for dislocation velocity appears to be the velocity of sound in the crystal. The effects of temperature, impurities, and radiation damage on dislocation velocity are described. These variables affect the dynamic resistance to motion encountered by a moving glide dislocation. The growth of total dislocation density, the growth of individual glide bands, and the distribution of glide dislocations during plastic deformation are described. The yield stress of LiF is determined by the resistance to motion encountered by a glide dislocation in moving through an otherwise dislocation-free region of the crystal. The yield stress is independent of the dislocations present in an undeformed crystal, and the state of pinning and geometrical arrangement of such dislocations do not affect the yield stress. Stress-strain curves were calculated from the data on dislocation mobility and dislocation density, and the calculated and measured curves are compared. At low strains the flow stress can be predicted from measured dislocation properties.

539.2

4020. THE DISLOCATION AS AN ELEMENTARY STRAIN SOURCE. E.Kroner.

Z. Naturforsch., Vol. 11a, No. 12, 969-85 (1956). In German.

The position of strain theory in the continuum of solids is discussed. Every strain source is traced to the dislocation as an elementary source. A basic equation relating the distortion tensor to the dislocation density tensor is derived. The pointwise slip of the lattice can be described in terms of an infinitesimal movement of a dislocation or of slip and stress dipoles as characteristic quantities with certain elastic polarizability. There is a simple formula for their mutual exchange with the elastic field. P.Gray

539.2

4021. THE GENERATION OF DISLOCATIONS BY THERMAL STRESSES. P.Penning.

Philips tech. Rev., Vol. 19, No. 12, 357-64 (1957-58).

During the pulling of germanium and silicon crystals from the melt, a process widely employed in practice, a nonuniform temperature gradient arises. As a result, thermal stresses are formed in the material which may cause plastic flow or even fracture of the material. Some experiments are described concerning the influence of the rate of cooling of a germanium rod on the state of internal perfection of the material. The latter can be judged, after polishing and etching, by the number of etch pits observed under the microscope and their distribution over a cross-section of the rod. These etch pits are formed at those places where a dislocation line terminates at the face of the cross-section. The distribution and density of the dislocations depend on the spatial distribution of the thermal stresses. These stresses are derived for a cylindrical rod with radial heat flux. For various crystallographic orientations of the rod, theoretical patterns of etch-pit distribution are derived which are in very good agreement with the figures observed. The theoretical figures are based on the assumption that the stresses are only partially relieved by plastic flow. This assumption, evidently justified by the good agreement found, throws an interesting light on the properties of dislocations in homopolar substances such as germanium.

539.2

4022. THE BINDING ENERGY OF NITROGEN IN A DISLOCATION. H.A.Wriedt and J.C.Swartz; W.R.Thomas and G.M.Leak.

Proc. Phys. Soc, Vol. 72, Pt 4, 673-4, 674-5 (Oct., 1958).

It is shown that the correction of an error in the mathematical treatment by Thomas and Leak (Abstr. 2265/1956) yields a value of 0.8 eV/atom for the binding energy of N in a dislocation. R.F.Peart

539.2 : 539.18

4023. INFLUENCE OF MASS RATIO ON DISPLACEMENT CASCADES IN DIATOMIC SOLIDS. E.M.Baroody.

Phys. Rev., Vol. 112, No. 5, 1571-6 (Dec. 1, 1958).

The influence of mass ratio on the displacement cascade initiated when an atom of a solid of type AB receives considerable energy is investigated for a simple model. Isotropic scattering, equal probabilities for collisions of various pairs of atoms, and a single threshold energy for displacement are assumed. The formulation of the problem is like that of Harris, but threshold energy is introduced in the manner of Kinchin and Pease. Comparatively simple equations are obtained and solutions which are always approximately correct have been found by the Laplace transform method. The total number of displacements does not vary greatly with mass ratio. When the mass of the heavy atom is more than about ten times that of the light, the difference between the numbers of A atoms and B atoms displaced by a primary A atom increases as a fractional power of the primary energy. For smaller mass ratios, the difference approaches a constant. To illustrate some implications of the results, the relative numbers of A and B atoms displaced by incident monoenergetic protons are considered.

539.2

4024. EVIDENCE FOR VACANCY CLUSTERS IN DISLOCATION-FREE Ge. A.G.Tweet.

J. appl. Phys., Vol. 29, No. 11, 1520-2 (Nov., 1958).

This note reports evidence for the existence of vacancy aggregates in Ge crystals. When dislocations are absent over volumes of the order of cubic centimetres the crystal etches much more rapidly than when dislocations are present. This enhanced etching behaviour can be eliminated by appropriate heat treatment at 800°C. Ridges of normal etching rate have been observed traversing the rapidly etched areas in ⟨110⟩ directions. Etch figures, usually spiral dislocations, are always associated with these ridges. Ridges are not observed in completely dislocation-free crystals.

539.2

4025. ENTROPY OF VACANCIES IN IONIC CRYSTALS. O.Theimer.

Phys. Rev., Vol. 112, No. 6, 1857-60 (Dec. 15, 1958).

The entropy of vacancies in sodium chloride is calculated from the ionic displacements produced by the Coulomb field of the vacancies and from the corresponding changes of the lattice frequencies. Using the displacements recently calculated by Tosi and Fumi it is found that, contrary to earlier expectations, the sum of all the frequency changes is positive. Some physical consequences of this result are discussed.

539.2

4026. STATISTICAL FLUCTUATION OF FRENKEL DEFECTS ARISING FROM PRIMARY "KNOCK-ON" PARTICLES. G.Leibfried.

Nukleonik, Vol. 1, No. 2, 57-9 (July, 1958). In German.

The probability distribution is calculated for the number of Frenkel pairs arising from a primary knock-on. Using the model put forward by Kinchin and Pease (see Abstr. 1417/1956) and assuming hard-sphere collisions, expressions are derived for the mean number and mean square number of Frenkel pairs. It is concluded that, for the multiple displacements produced by high energy neutrons, the peak in the probability distribution is relatively sharp.

J.Thewlis

539.2

4027. THE MEAN FREE PATH OF EXCITONS IN POLAR CRYSTALS. H.Haken.

Z. Naturforsch., Vol. 11a, No. 10, 875-6 (1956). In German.

An expression is derived for the mean free life time of excitons which with the exciton velocity gives the mean free path.

G.F.J.Garlick

539.2

4028. THE THEORY OF DIFFUSION OF "LOCALIZED" EXCITONS IN SOLIDS. M.Trlifaj.

Czech J. Phys., Vol. 6, No. 6, 533-50 (Dec., 1956). In Russian.

A diffusion equation is derived by means of a time-dependent perturbation calculus of quantum mechanics, and its coefficient of diffusion is determined as a function of the temperature. The "localized" state is considered to be that excited state of the atom of the crystal propagating through the crystal and accompanied by local deformation of the crystal lattice. The excitational probability of the atom in the crystal is taken as the characteristic quantity describing the motion of the exciton.

539.2 : 537.312.5

4029. INTERNAL PHOTOEFFECT AND EXCITON DIFFUSION IN CADMIUM AND ZINC SULFIDES. M.Balkanski and R.D.Waldron.

Phys. Rev., Vol. 112, No. 1, 123-35 (Oct. 1, 1958).

The spectral response of photoconductivity of ZnS and CdS for both single-crystal and sintered-powder samples was measured for several distances between the area of illumination and the electrode region. The energy transport process for indirect illumination was studied by measuring the photocurrent pulses produced by high-intensity light flashes and by experiments with light transmission and electric fields. These studies demonstrate energy transport by electrically neutral entities other than photons, which we interpret as diffusion of excitons or mobile electron-hole pairs. This indirect or transfer photocurrent occurs predominantly at frequencies below the absorption edge of the crystal, with the detailed response being sensitive to the impurity content of the samples. The diffusio parameters in this region generally lie in the following range: lifetime $\tau = 10^{-4}$ to 10^{-6} sec, diffusion constant $D = 10^3$ to 10^4 cm^2/sec, and diffusion length $L = 0.1$ to 1 cm. The transfer photocurrent for steady illumination shows a nearly linear dependence on the incident light intensity. The slow decay of the photocurrent indicates that trapping processes are important in the photocurrent mechanism. Measurement of photocurrent pulses for flash illumination shows a greater than linear dependence on intensity, indicating a second-order or bimolecular process. A proposed mechanism for the transfer photoeffect involves initial absorption of the light with creation of an exciton, which diffuses to a trap in the lattice. A second exciton reaching the trap then dissociates, using energy transferred from the trap.

539.2 : 537.226.1

THEORY OF THE CONTRIBUTION OF EXCITONS TO THE COMPLEX DIELECTRIC CONSTANT OF CRYSTALS. See Abstr. 3419

539.2

4030. SEGMENTAL MOTION IN POLYPROPYLENE. J.A.Sauer, R.A.Wall, N.Fuschillo and A.E.Woodward.

J. appl. Phys., Vol. 29, No. 10, 1385-9 (Oct., 1958).

Molecular motion in polypropylene was studied both by measurements of dynamic mechanical properties and by observations of nuclear magnetic resonance line shapes. The mechanical measurements were made in the audio-frequency region over the temperature range from 80°K to the melting point. Both completely amorphous and highly crystalline samples of polypropylene were investigated. In the amorphous sample, two transitions were observed, a broad but weak secondary one near 235°K and a relatively sharp primary one occurring near 270°K. For the highly crystalline polypropylene, two transitions centred at 250°K and 300°K respectively are associated with increased mobility in the amorphous regions and a third higher temperature transition is associated with crystalline melting. These transitions have also been investigated by observing the changes occurring in NMR line shapes as the temperature is varied.

539.2

4031. MOLECULAR MOTION IN POLYPROPYLENE, ISOTACTIC AND ATACTIC. W.P.Slichter and E.R.Mandell.

J. appl. Phys., Vol. 29, No. 10, 1438-41 (Oct., 1958).

For preliminary report see Abstr. 8433 (1958). Molecular order and motion in isotactic and atactic polypropylene molecules were studied by proton magnetic resonance methods over the temperature range 77-400°K, and by X-ray diffraction. It is shown that some motion persists at the lowest temperatures, and becomes pronounced in the temperature interval 77-110°K. This behaviour is ascribed to motion of the methyl groups about the threefold axis. The resonance undergoes further narrowing near room temperature for the atactic polymer, presumably owing to rotational and translational motions of chain segments. The isotactic compound possesses a narrow resonance superposed on a broad absorption over a wide temperature range. The former, ascribed to the amorphous regions, narrows at higher temperatures than for the atactic polymer, presumably owing to constraints imposed by the crystalline regions. The chains of the isotactic compound are less mobile than in polyethylene, as shown by the resonance studies and by X-ray diffraction comparisons of the rate of crystallization.

539.2 : 537.533.73

APPLICATIONS OF ELECTRON DIFFRACTION TO THE STUDY OF POLYMER STRUCTURE. See Abstr. 3573

539.2

4032. INFRARED SPECTRA OF HEAT TREATMENT CENTERS IN SILICON. H.J.Hrostowski and R.H.Kaiser.
Phys. Rev. Letters, Vol. 1, No. 6, 199-200 (Sept. 15, 1958).

Measurements mainly at 4.2°K suggest that oxygen in silicon produces several discrete heat treatment centres which can be formed by the clustering of small numbers of oxygen atoms during heating near 450°C. C.A.Hogarth

539.2 : 537.311.33

4033. MECHANISM OF THE FORMATION OF DONOR STATES IN HEAT-TREATED SILICON. W.Kaiser, H.L.Frisch and H.Reiss.
Phys. Rev., Vol. 112, No. 5, 1546-54 (Dec. 1, 1958).

A mechanism for the donor formation during heat treatment of silicon crystals is presented which accounts quantitatively for the complex kinetic phenomena and which is consistent with the known extra-kinetic information concerning this system. Atomically dissolved oxygen introduced during the growth of the silicon crystal reacts, in the course of heat treatment, to form a sequence of kinetically linked aggregates till finally a polymeric silica (SiO_2) is formed. Only those aggregates which possess fewer than five bound oxygen atoms appear to act intensively as donors at room temperature, and in particular donor states produced around 450°C appear to consist principally of a donor [SiO_4] complex. The kinetic equations are integrated using a general-purpose analogue computer for a variety of initial concentrations of oxygen, temperature, etc., and the results compare favourably with existing experimental observations.

539.2

4034. THEORETICAL CALCULATION OF DISTRIBUTION COEFFICIENTS OF IMPURITIES IN GERMANIUM AND SILICON, HEATS OF SOLID SOLUTION. K.Weiser.
J. Phys. Chem. Solids, Vol. 7, No. 2-3, 118-26 (Nov., 1958).

The distribution coefficients of Groups III, IV and V impurities in germanium and silicon were calculated, and very satisfactory agreement with experimental values was obtained. The method of calculation consisted in estimating the change in energy involved in transferring the impurity atoms from a crystalline reservoir to the solid and molten host material respectively. The binding energy of an impurity in the host lattice and the strain energy which it introduces were estimated. The change in vibrational entropy is believed to be negligible.

539.2 : 535.345

THE POSITION OF THE ABSORPTION BANDS OF IMPURITY CENTRE ELECTRONS IN IONIC LATTICES. See Abstr. 3305

539.2 : 537.311.33

4035. RECOMBINATION PROPERTIES OF GOLD IN SILICON. G.Bemski.
Phys. Rev., Vol. 111, No. 6, 1515-18 (Sept. 15, 1958).

The presence of gold atoms in the silicon lattice decreases the lifetime of excess electrons and holes in p- and n-type material. The capture of electrons in p-type silicon occurs through the gold donor level with a capture cross-section, σ_{no}, of 3.5×10^{-15} cm^2 (at 300°K). This capture cross-section varies as $T^{-2.5}$ between 200° and 500°K. In n-type silicon the electron capture cross-section, σ_{no}, is 5×10^{-16} cm^2 at 300°K and is temperature independent; the hole capture cross-section, σ_{po}, is 1×10^{-15} cm^2 at 300°K and varies as T^{-4}. The capture in this case occurs through the gold acceptor level.

539.2

4036. VOLUME RECOMBINATION IN ALUMINIUM-DOPED GERMANIUM. S.G.Kalashnikov and K.P.Tissen.
Zh. tekh. Fiz., Vol. 28, No. 9, 1890-5 (1958). In Russian.

The crystals were grown under vacuum, using intrinsic Ge and zone-refined Al. The electron lifetimes, τ, in about 50 specimens were measured by the light spot method on etched surfaces with an illuminated collector. For undoped material $\tau \simeq 4 \times \times 10^{-3}$ sec; for Al-doped material with 10^{17} holes/cm^3, $\tau \simeq 10^{-4}$ sec. This drop was satisfactorily explicable on the Shockley-Read theory as due to the shift of the Fermi level, without any need to assume a recombination contribution through the Al centres. An upper limit of 10^{-19} cm^2 was obtained for the electron capture cross-section of the Al^- centre. K.F.Hulme

539.2 : 539.18

4037. ANALYTIC HARTREE—FOCK SOLUTIONS FOR $O^=$. R.E.Watson.
Phys. Rev., Vol. 111, No. 4, 1108-10 (Aug. 15, 1958).

$O^=$ ions exist in solids but not in a free state. Analytic Hartree—Fock solutions have been obtained for the ^1S state of $O^=$ which can be applied to work in solids. The solutions utilize stabilizing potential wells of positive charge and the results are compared with other published work.

539.2

4038. ENERGIES OF GRAIN BOUNDARIES IN SILVER CHLORIDE CRYSTALS. K.A.McCarthy and B.Chalmers.
Canad. J. Phys., Vol. 36, No. 12, 1645-51 (Dec., 1958).

The relative energies of grain boundaries in silver chloride crystals were measured. The measurements were made on tricrystals grown by simultaneously drawing three single crystals vertically from a melt. Tricrystals of three different isoaxial orientations, ⟨100⟩,⟨110⟩, and ⟨111⟩, were studied. The relative grain boundary energies were measured as a function of the orientation differences between two grains forming a boundary in crystals of each of the orientations given above. From these measurements the following conclusions are drawn: the grain boundary energies of silver chloride follow the equation of Read and Shockley; for small orientation differences, that is, differences less than 10°, the boundary energy is a function of the axial orientation of the grains forming the boundary; for large orientation differences, that is, differences greater than 10°, the boundary energy is not a function of the axial orientation, except when cusps occur; the maximum energy of a boundary made of crystals each with a ⟨100⟩ axial orientation equals the maximum energy of a boundary between crystals of ⟨110⟩ axial orientations.

539.2

4039. CLASSIFICATION OF RELAXATION PROCESSES IN CRYSTALS. G.Falk and J.Meixner.
Z. Naturforsch., Vol. 11a, No. 10, 782-91 (1956). In German.

Relaxation processes are normally described in terms of the specific entropy and components of the strain tensor (or the temperature and components of the stress tensor and certain "inner variables" denoting possible internal transformations. By group-theoretical methods the internal variables are classified according to their transformation properties with respect to the symmetry group of the crystal. The results are discussed in terms of their bearing on the mechanical-thermal relaxation processes of isotropic bodies and of representatives of the various crystal systems. T.P.Brody

539.2

4040. EFFECTS OF TRANSLATIONAL DIFFUSION ON NUCLEAR SPIN RELAXATION IN SIMPLE CONDENSED SYSTEMS. H.C.Torrey.
Nuovo Cimento Suppl., Vol. 9, No. 1, 95-100 (1958).

It is shown how to obtain values for activation energies for the motion of protons in the hydrides of certain transition metals. Some results are given for $PdH_{0.64}$, $TiH_{1.77}$, $TaH_{0.75}$. R.F.Peart

539.2

4041. SPIN—LATTICE RELAXATION TIME FOR I^{127} IN KI IN THE TEMPERATURE RANGE 2°K TO 20°K. C.V.Briscoe and C.F.Squire.
Phys. Rev., Vol. 112, No. 5, 1540-3 (Dec. 1, 1958).

The spin—lattice relaxation time, T_1, for I^{127} in both single crystal and powdered KI was measured in the temperature range 2°K to 20°K using a Pound—Watkins type nuclear magnetic resonance spectrometer. In the liquid hydrogen temperature range T_1 is approximately the same for both the single crystal and the powder specimens, varying from 20 sec at 20°K to 70 sec at 14°K. Both the temperature dependence and the magnitude of T_1 in this temperature range can be explained on the basis of a theory of nuclear quadrupolar spin—lattice relaxation proposed by Van Kranendonk. In the liquid helium temperature range (2°K to 4°K), T_1 is constant within experimental error. For the single crystal $T_1 = 6.9 \times 10^3$ sec and for the powder specimen $T_1 = 6.0 \times 10^2$ sec in this temperature range. These values of T_1 are less by orders of magnitude than is predicted using Van Kranendonk's theory. The I^{127} resonance (spin $I = \frac{5}{2}$ in units of $\hbar$) consisted of a narrow (less than 1 gauss half-width) central line with broad (> 15 gauss) weak wings. This is attributed, according to Pound, to a shift in the nuclear magnetic energy levels brought about by the interaction of the nuclear quadrupole moment with electric field gradients present in the specimens.

539.21

4042. THE SURFACE HARDENING OF X-IRRADIATED NaCl. E.Aerts, S.Amelinckx and W.Dekeyser.
Acta metallurgica, Vol. 7, No. 1, 29-42 (Jan., 1959).

The increase in Vickers hardness due to exposure of NaCl single crystals to 40 kV unfiltered X-rays is studied both as a function of irradiation time and of depth, i.e. the distance from the surface facing the beam. The optical absorption was also measured, as a function of these variables, on the same crystals in order to find a possible correlation between the hardness increase and colour centre concentration. The effect of optical and thermal bleaching was also followed. It is found that the hardness near to the surface is influenced by the presence of a free surface; when thin specimens are used an increase in hardness is found on both surfaces. All observations can satisfactorily be explained if the surface hardening is assumed to be due to the formation of small colloids. The hardening is then quite similar to precipitation hardening in an alloy. The formation of the colloids is analogous to the "printing-out" process in silver bromide exposed to light.

539.21

4043. INVESTIGATION OF VARIOUS PROPERTIES OF POLYETHYLENE SUBJECTED TO THE EFFECT OF γ-RADIATION.

B.I.Sazhin, A.M.Lobanov, A.L.Gol'denberg, T.N.Sarminskaya, I.A.Marakhonov and S.P.Kabin.

Zh. tekh. Fiz., Vol. 28, No. 9, 1991-8 (1958). In Russian.

The condition of polymers was investigated by measuring the infrared absorption spectrum, the degree of crystallization as shown by X-rays, the density, the loss angle in mechanical and electric oscillations in,dependance on the temperature and Young's modulus at various temperatures. Using these criteria, the effect of γ-radiation on polymers was studied. With polyethylenes and mixtures of polyethylenes and polyisobutylenes a marked influence of irradiation is found from which the authors conclude that the structure of the macromolecules is appreciably changed. Experimental results are shown in a number of diagrams.

R.Eisenschitz

539.21 : 539.17

4044. RADIATION EFFECTS FROM (n,α) REACTIONS IN BORON GLASS AND ENERGY OF THE REACTING NEUTRONS.

C.Mylonas and R.Truell.

J. appl. Phys., Vol. 29, No. 8, 1252-60 (Aug., 1958).

The damage produced in neutron irradiated boron glass by the products of the (n,α) reaction appears as a pronounced optical birefringence. This birefringence is shown to be due to macroscopic stresses resulting from volume contraction of the glass. The variation of strain with depth from the glass surface is found to fit to a remarkable degree the space rate of decay of radiation of suitable velocity distribution and random direction. This permits the determination of the neutron velocity by one-velocity theory, or of the most probable velocity for a Maxwellian neutron distribution; in addition the average volume contraction corresponding to a single neutron—boron reaction is found to be equal to 3.6×10^{-19} cm^3 per (n,α) reaction.

539.21 : 537.311.33

4045. EFFECT OF MONOENERGETIC FAST NEUTRONS ON N-TYPE GERMANIUM.

S.L.Ruby, F.D.Schupp and E.D.Wolley.

Phys. Rev., Vol. 111, No. 6, 1493-6 (Sept. 15, 1958).

The density of vacancy-interstitial pairs produced per unit of fast-neutron flux on n-type germanium was measured experimentally using monoenergetic neutrons. The changes in resistivity and Hall coefficient have been determined as a function of neutron flux and energy for n-type germanium having impurity concentrations of about 2×10^{12} cm^{-3}. Both the irradiation and electrical measurements were made at about 77°K. Neutron energies in the experiment were 4.8, 3.2 and 1.7 MeV from the $H^2(d,n)He^3$ reaction and the observed changes in resistivity and Hall coefficients indicate charge carrier removal rates per unit of neutron flux, $-dn/d\phi$, of 12, 12, and 21, respectively. Not only do the results appear much lower than the value of 160 calculated by current models, but they are less than would be estimated by extrapolating the results obtained with reactor neutron irradiations.

539.21

4046. NEUTRON-BOMBARDMENT DAMAGE IN SILICON.

G.K.Wertheim.

Phys. Rev., Vol. 111, No. 6, 1500-5 (Sept. 15, 1958).

Neutron-bombardment damage in silicon is compared to electron-bombardment effects which have been previously analysed. A discrete energy level 0.27 eV above the valence band previously ascribed to the acceptor member of a defect pair having a separation greater than 50 A, is found to be produced by both neutrons and electrons. A spectrum of energy levels running from 0.16 eV below the conduction band toward the middle of the gap is ascribed to a defect pair with variable spacing, and related to the discrete level 0.16 eV below the conduction band which was found previously in electron-bombardment of silicon, and there ascribed to a close-spaced pair of defects. Lifetime effects are found to be dominated by levels near the middle of the energy gap, which may be related to the above spectrum. A very rapid decrease in mobility at low temperature is ascribed to bombardment-induced inhomogeneities.

539.21

4047. BOMBARDMENT OF CADMIUM SULFIDE CRYSTALS WITH 30 TO 60 keV ELECTRONS.

C.E.Bleil, D.D.Snyder and Y.T.Sihvonen.

Phys. Rev., Vol. 111, No. 6, 1522-6 (Sept. 15, 1958).

The dependence of induced conductivity in CdS crystals on the rate of arrival and the energy of impinging electrons is reported. These results lead to a qualitative picture of the conduction, excitation, and recombination phenomena in CdS which is satisfied by the simple model of a sulphur vacancy, and an analytical expression which involves the mobility of carriers, their effective masses, the number of ground states in the forbidden gap (for pure but not perfect crystals) and their positions as a function of temperature. The red and green luminescence observed under irradiation by electrons is qualitatively explained. The equation for the induced conductivity is derived from the expression for two-carrier conductivity and the definitions of the steady-state Fermi levels for holes and electrons. An empirical fit to the observed data yields $\sigma = e\mu_n N_c \exp(kT\alpha I - E_{fn}^0)/kT$ for $I < I_s$ and $\sigma = e(\mu_n + \mu_p)N_v \exp \times \times [kT\beta(I - I_s) - E_{fp}^0]/kT$ for $I < I_s$. The data reported herein were obtained by using monoenergetic bombarding electrons in the range of 30 to 60 keV. An interesting field effect is reported but no clear interpretation is available to the authors. Corroborating data employing ultraviolet irradiation are described.

539.21

4048. STUDY OF REACTOR-IRRADIATED α-Al_2O_3.

J.J.Antal and A.N.Goland.

Phys. Rev., Vol. 112, No. 1, 103-111 (Oct. 1, 1958).

Studies are presented here on reactor-irradiated alpha aluminium-oxide single crystals. These are a continuation of the use of long-wavelength neutron transmission for determining the concentration and types of defects produced in solids by high-energy particle irradiation. The material exhibited crystallographic stability to fast-neutron irradiation at temperatures < 40°C, and the results indicate a total number of defects approximately 40 times less than that predicted by current theories. Correlation with macroscopic density changes is good. Examination of the wavelength dependence of the neutron scattering indicated that the damage may be partly Al—O vacancy pairs at room temperature. Annealing of the material produced no decrease in the concentration of defects from room temperature to 400°C, a steady decrease from 400°C to 1250°C, and nonuniform changes in neutron scattering and visually observable optical colouring beyond 1250°C. Annealing at a temperature of 1800°C did not remove the colouring, although the density returned to its pre-irradiation value.

539.21

4049. Li^7 AND F^{19} NUCLEAR MAGNETIC RESONANCES IN NEUTRON IRRADIATED LiF.

P.J.Ring, J.G.O'Keefe and P.J.Bray.

Phys. Rev. Letters, Vol. 1, No. 12, 453-4 (Dec. 15, 1958).

Neutron irradiation of $\sim 10^{19}$ nvt of a single crystal of lithium fluoride resulted in sharp resonances for both F^{19} and Li^7 superimposed on the usual broad lines. The F^{19} sharp resonance (4 kc/s) corresponds to 7% of the fluorine nuclei and is shifted 0.07% to highe frequencies and may be molecular fluorine. The Li^7 sharp line is also shifted and may be due to metallic lithium. This is in agreement with X-ray measurements (Abstr. 8938/1957).

J.G.Powles

539.21 : 534.133

FREQUENCY ALTERATION OF A THICK X-CUT QUARTZ CRYSTAL, PRODUCED BY NEUTRON BOMBARDMENT.
See Abstr. 3221

539.21 : 535.371

MODELS FOR LUMINESCENCE DEGRADATION IN ORGANIC SOLIDS. See Abstr. 3314

STRUCTURE OF SOLIDS

539.214

4050. THEORY OF CRYSTAL PLASTICITY. IV. HARDENING AND GLIDE MECHANISM OF DENSEST PACKED METALS AND ALLOYS. A.Seeger.
Z. Naturforsch., Vol. 11a, No. 12, 985-98 (1956). In German.

For Pt III see Abstr. 2250 (1955). After a general survey of the theory, the plastic behaviour of the hexagonal metals Zn, Cd, Mg is discussed. For these metals at room temperature "dynamic recovery" takes place, involving dislocation climb as in "static recovery". The properties of homogeneous face-centred cubic alloys are discussed in relation to pure metals (see Abstr. 4817/1957); the properties considered are the suppression of glide-band formation, latent hardening and "overshoot". B.T.M.Willis

539.217

4051. A METHOD FOR DETERMINATION OF PARTICLE PENETRATION DEPTHS IN A FILTER. J.Sisefsky.
Nature (London), Vol. 182, 1437-8 (Nov. 22, 1958).

The following simple method has been devised for the determination of particle penetration: an aerosol consisting of radioactive solid particles 0-2 μ in diameter, is filtered at an air velocity of 100 cm/sec through a glass-fibre paper details of which are given; 225 cm^2 of the filter is pressed against a gummed cellulose acetate film, with the air-entry side of the filter downmost. On removal, a thin layer of glass fibre is left on the sticky surface. The process is repeated until the whole filter is divided into 20 such layers each about 10 μ thick whose weights after ashing of the sticky film average 60 mg. Each layer is radioautographed and the γ-activity measured with a scintillation counter. From the data obtained, the sizes of the different particles are approximately determined. It is found that the bigger particles are more likely to penetrate deep into the filter than the smaller ones, indicating that they are shot into the filter by the fast air stream, pushing the fibres out of the way and penetrating deeper, the more momentum they have, instead of being stopped by the first filter fibre encountered. H.H.Hodgson

539.217

4052. MAGNETIC RESONANCE STUDIES OF SELF-DIFFUSION IN SIMPLE SOLIDS. C.P.Slichter.
Nuovo Cimento Suppl., Vol. 9, No. 1, 104-11 (1958).

This is a general review of previously published theory and experimental results. Possible reasons are given to explain differences in the activation energy for Al obtained by these and other methods. A technique is offered by which magnetic resonance studies might be extended so that the activation energy may be separated into an energy of formation and an energy of motion. R.F.Peart

539.217 : 539.17

4053. DIFFUSION OF FISSION-PRODUCED XENON IN URANIUM OXIDE. F.Felix.
Nukleonik, Vol. 1, No. 2, 66-7 (July, 1958). In German.

The test-pieces (UO_2 layers 10-13 μ thick on Al, U_3O_8 powder and tablets) were exposed for 24 hours to a neutron flux of 10^{11} n/(cm^2 sec), and the measurements started five days later. It was found that the amount of released X rises rapidly at a given temperature to a certain saturation value which lasts for a relatively long time. A rise in temperature causes again a rise of X activity in the gas space, this rise lasting longer and longer as the temperature changes from 200 to 500°C. The results of experiments conducted in the temperature interval 200-1000°C seem to indicate that the X generation rate attains a minimum at 700°C. F.Lachman

539.217

4054. CORRELATION CORRECTION TO THE ACTIVATION ENERGY FOR DIFFUSION IN CRYSTALLINE SOLIDS. J.R.Manning.
Phys. Rev. Letters, Vol. 1, No. 10, 365-7 (Nov. 15, 1958).

Possible effects of correlation (LeClaire and Lidiard, Abstr. 8477/1956) on diffusion parameters are examined and compared with results for the diffusion of impurities in Ag. R.F.Peart

539.217 : 532.5

MISCIBLE DISPLACEMENT IN POROUS MEDIA. See Abstr. 3187

539.217 : 539.17

DIFFUSION OF THE FISSION XENON FROM METALLIC URANIUM. See Abstr. 3935

539.217.1

4055. POROSITY DETECTION IN MAGNESIUM ALLOYS USING PARAFFIN CONTAINING Pd^{109}. S.M.Makin.
Internat. J. appl. Radiation and Isotopes, Vol. 4, No. 3-4, 253-5 (Jan., 1959).

Surface porosity in magnesium alloys was detected by autoradiography. Pores extending from a surface area of 1.5×10^{-5} cm^2 and within 0.4 mm of the surface can be detected on samples which have been soaked in hot oil containing Pd^{109}. A polished surface and a finish equivalent to 0000 grade emery gave satisfactory autoradiographs, but roughly turned samples were unsuitable.

539.219

4056. SOLID SOLUTIONS OF ARGON AND KRYPTON. R.Heastie and G.O.Jones.
Nuovo Cimento Suppl., Vol. 9, No. 1, 365-8 (1958).

The complete solid—liquid phase equilibrium diagram for the system A—Kr and the vapour pressures of the solid and the liquid have been established. There is positive deviation from ideality in the solid solution, but no phase separation has been detected at low temperatures. The excess free energy of the solid is in good agreement with values calculated from the cell theory over the whole range of compositions. R.O Davies

539.22 : 538.245

4057. ANISOTROPY ENERGY IN MnF_2 AT LOW TEMPERATURES. T.Oguchi.
Phys. Rev., Vol. 111, No. 4, 1063-6 (Aug. 15, 1958).

The anisotropy energy in MnF_2 is calculated by a spin-wave method. The magnetic dipole interactions and the interactions of individual ions with their surrounding crystalline fields give the anisotropy energy of -4.9×10^6 erg/cm^3 at 0°K. The experimental value extrapolated to 0°K by Foner is -5.0×10^6 erg/cm^3. The temperature dependence of the anisotropy energy is obtained as $E_{an}(T)/E_{an}(0) = [M(T)/M(0)]^{2.9}$, where $E_{an}(T)$, $M(T)$ are the anisotropy energy and the magnetization of the sublattice at T°K, respectively, and $E_{an}(0)$, $M(0)$ are the corresponding values at 0°K.

539.22 : 539.32

4058. EFFECT OF ANISOTROPY ON THE TEMPERATURE DEPENDENCE OF ELASTIC CONSTANTS. R.F.Greene.
Phys. Rev., Vol. 111, No. 6, 1505-7 (Sept. 15, 1958).

It is suggested that an important part of the temperature dependence of the elastic constants of perfect crystals arises from the elastic anisotropy itself without reference to the features of any model of the interaction between the atoms. The intrinsic effect of the anisotropy is introduced via the local oscillatory rotations produced in a crystal by transverse acoustic vibrations. The elastic properties belonging to different directions are thereby mixed, in proportion to the temperature. A linear temperature dependence of the elastic constants and a partial averaging-out of the anisotropy results. Application is made to the elastic constants of β brass.

539.23

4059. INVESTIGATION OF THE CONDENSATION OF SILVER ATOMS ON MOLYBDENUM. Yu.G.Ptushinskiĭ.
Zh. tekh. Fiz., Vol. 28, No. 7, 1402-7 (1958). In Russian.

The condensation of Ag atoms on clean surfaces of polycrystalline Mo, single Ge crystal, mica and glass was studied by radioactive tracer technique. The total pressure of the residual gases and the pressure of the condensating part of these gases were $< 3 \times 10^{-9}$ and 2×10^{-10} mm Hg respectively, and in the investigated range of the surface concentration of the condensed atoms (2×10^{13}-3×10^{15} atoms/cm^2) the condensation coefficients for Mo, Ge, mica and glass were 1.0, 0.96, 0.92 and 0.89 resp. The condensation was inhibited by surface contaminants but was not affected either by variation of density of the atomic jet or by the change of temperature in the range 300-800°K. Above 800°K the rate of condensation decreased due to volatilization of deposited Ag. The heat of desorption of Ag atoms from the surface of Mo was determined as L = 1.5 eV. M.H.Sloboda

539.231 : 537.534

4060. SPUTTERING OF A POLYCRYSTALLINE SILVER SURFACE BOMBARDED WITH MONOENERGETIC ARGON IONS OF LOW ENERGY (40-240 eV). M.Koedam.
Physica, Vol. 24, No. 8, 692-4 (Aug., 1958).

Describes the experimental arrangement, and gives the results as a graph of the number of sputtered atoms per incident ion (y) v. ion energy; y increases with ion energy from about 0.1 to 1.6 with no well defined threshold in the range investigated. J.Dutton

539.231

4061. CONTEMPORARY THEORIES OF CATHODIC SPUTTERING AND THE MICRORELIEF OF THE ERODED METAL SURFACE.

V.E.Yurasova.

Zh. tekh. Fiz., Vol. 28, No. 9, 1966-70 (1958). In Russian.

Crystallographic etch-pits on Zn and Cu single crystals and etch-pits along slip traces in deformed Zn were produced by positive ion bombardment in rare-gas low-pressure discharges; photographs are shown. The observations of Wehner (Abstr. 6210/1956), that sputtered metal atoms are preferentially directed along the close packed directions of the crystal, were confirmed and extended to higher voltages on Cu in a Kr discharge (up to 4 kV and 5-20 mA/cm^2). It was shown that in thermal evaporation from solid Cu there are no preferential directions of evaporated atoms. These results are discussed. K.F.Hulme

539.232

4062. STUDY OF CUPROUS OXIDE FORMED IN AIR AT 0.5 mm OF Hg BETWEEN 200°C AND 1030°C AND ITS RECTIFICATION.

K.R.Dixit and V.V.Agashe.

Z. Naturforsch., Vol. 12a, No. 2, 96-101 (1957).

Oxides of copper formed at an air pressure of 0.5 mm Hg in the range 200-1030°C for a time of formation of one hour have been studied as regards composition, structure from X-ray and electron diffraction, rectification, and magnetic susceptibility. Films formed at 500°C just show rectification effects which become appreciable at 800°C and then improve for an increasing temperature of formation. The rectifying films are forms of Cu_2O but the rectification effects are found to depend on composition, crystallite size, and crystallite orientation. C.A.Hogarth

539.234 : 537.228 : 548.74

4063. THE EFFECT OF ELECTRIC FIELD UPON THE STRUCTURE OF THIN FILMS OF SOME DIPOLAR LONG-CHAIN MOLECULES.

K.Harada and T.Sakai.

Mem. Coll. Sci. Univ. Kyoto A, Vol. 28, No. 4, 283-92 (May, 1958).

The effect of static electric field applied to thin films of stearic acid and octadecyl alcohol upon the structure of the films was investigated by the method of electron diffraction. The electric field was applied when the films were formed by evaporation of solution or by melting. In the case of stearic acid, some definite relation between the orientation of the crystals in the film and the direction of the applied field was found. While, in the case of octadecyl alcohol, the applied field affected the lattice dimension of the crystals.

539.234

4064. ON THE ORIENTATION OF METAL LAYERS EVAPORATED ON TO THE SURFACES OF COPPER SINGLE CRYSTALS (ACCORDING TO ELECTRON DIFFRACTION OBSERVATIONS).

O.Haase.

Z. Naturforsch., Vol. 11a, No. 10, 862-4 (1956). In German.

Cu, Ag, Au, Pd, Fe and Zn were evaporated on clean (111) planes of copper. Each face-centred metal was deposited with its (111) face on that of the copper crystal and followed very closely the orientation of the crystal face. Twinning was also observed. Fe (body-centted) was deposited with the (110) plane on the copper (111) so that the [001] direction of Fe was parallel to one of the three equivalent [110] directions lying in the (111) plane. For Zn it was found that the basal plane was deposited on the Cu (111) plane. J.Thewlis

539.234 : 537.311.33

EVAPORATED LAYERS OF SEMICONDUCTING III-V COMPOUNDS. See Abstr. 3455

539.26

4065. THE DIFFRACTION MICROSCOPY OF POLYDISPERSE SYSTEMS. I. INTERFERENCE THEORY OF A COLLECTION OF GLOBULAR PARTICLES.

D.Joerchel.

Z. Naturforsch., Vol. 12a, No. 2, 123-40 (1957). In German.

The analogy between X-ray and optical Fraunhofer diffraction is applied to the consideration of small angle X-ray scattering from systems of irregularly distributed globular particles having a Maxwell distribution in size. The two-dimensional case is considered for circular scattering discs and a scattering formula developed. The extension to three dimensions is also discussed. S.Tolansky

539.26

4066. DIFFRACTION MICROSCOPY OF POLYDISPERSE SYSTEMS. II. EXPERIMENTAL PART AND EVALUATION.

D.Joerchel.

Z. Naturforsch., Vol. 12a, No. 3, 200-12 (1957). In German.

The interference theory of polydisperse collections of particles previously developed (see preceding abstract) is now applied using models, and a test carried out of its validity. The structure parameters which include the main particle-radius, polydispersion and the packing density are computed. The calculations are in good agreement with observations. Formulae are derived for a three-dimensional case as well as for the two-dimensional case. The diffraction apparatus used is described in detail. Experimental errors are surveyed. A variety of particles is used in the experimental work. S.Tolansky

539.27

4067. TRANSMISSION ELECTRON MICROSCOPY OF BERYLLIUM.

J.D.Baird, O.P.Hartree and R.Phillips.

Nature (London), Vol. 182, 1660 (Dec. 13, 1958).

The authors have succeeded in preparing thin films of berylliu in which the dislocations can be seen directly in the electron microscope. Dislocation densities of $10^8/cm^2$ in single crystals have been observed. Experimental techniques are described.

A.E.I. Research Laboratory

539.27

4068. A MINIATURE SHADOWING APPARATUS FOR INCREASING THE CONTRAST IN ELECTRON MICROSCOPE SPECIMENS.

W.Degenhard and G.Möllenstedt.

Optik, Vol. 14, No. 6, 282-5 (June, 1957). In German.

A compact device for shadowing electron microscope specimen has been designed in which the distance between source and specime is greatly reduced. This enables a higher pressure to be employed in the apparatus. An aperture system preserves the sharpness of the shadows. A.E.I. Research Laboratory

539.27

4069. CONTROL OF A TECHNICAL PROCESS WITH THE ELECTRON MICROSCOPE, WITH SPECIAL REFERENCE TO THE POLISHING OF GLASS.

H.Poppa.

Optik, Vol. 14, No. 9, 411-24 (Sept., 1957). In German.

A study has been made of the relative value of the electron microscope, optical microscope and interference microscope in following the effects of polishing on a glass surface. The method of Bethge (Z. wiss. Mikr., Vol. 62, No. 2, 122-8, Dec., 1954) was used to get replicas from a given region of the surface at successive stages of the polishing process. The great depth of focus of the electron microscope was utilised for studying rugged surface detail, magnifications as low as 130× being employed to get a large field of view. On the other hand, the replica and metal shadowing procedures of electron microscopy were found to have great value in the optical microscope also. The depth of pits in the surface was measured by both methods of microscopy, by an interference microscope, and also stereoscopically, and all four results agree closely. V.E.Cosslett

539.27 : 539.21

4070. MODIFICATION OF THE SPECIMEN IN THE ELECTRON MICROSCOPE.

W.Lippert.

Optik, Vol. 15, No. 5, 293-303 (May, 1958). In German.

The change in weight (in $\mu g/cm^2$) of films exposed to the electron beam was determined as a function of the incident charge density (in Giga-Röntgen = 10^9 Röntgen). The current density was kept so low that temperature rise in the film could be neglected, any changes depending only on the amount of ionisation. Films of carbon and of polystyrene increase in weight during irradiation, whilst polymethylmethacrylate and "Zaponlack" show a loss; formvar films show little change. The loss of substance is shown to be a volume effect, the addition a surface effect. V.E.Cosslett

539.27 : 548.57

4071. A NEW TECHNIQUE FOR DECORATION OF CLEAVAGE AND SLIP STEPS ON IONIC CRYSTAL SURFACES.

G.A.Bassett.

Phil. Mag. (Eighth Ser.), Vol. 3, 1042-5 (Sept., 1958).

Describes a new technique which is able to display "unit lattice steps" on cleavage surfaces of NaCl. A small quantity of gold, deposited on the crystal surface by evaporation, is found to consist of nuclei which form along the edges of steps. On removing the gold deposit by depositing a film of carbon, to which the gold adheres, and stripping it off, these steps are rendered visible in the electron microscope as chains of gold particles. In this way monatomic steps have been seen. J.Thewlis

ELASTICITY . STRENGTH . RHEOLOGY

539.32

4072. ADIABATIC ELASTIC MODULI OF SINGLE CRYSTAL LPHA-URANIUM. E.S.Fisher and H.J.McSkimin.
J. appl. Phys., Vol. 29, No. 10, 1473-84 (Oct., 1958).

The adiabatic elastic moduli at 25°C for single crystal alpha-uranium are reported here as derived from measurements of high-frequency ultrasonic wave velocities. A detailed description is given of the specimens used, and of the technique employed for obtaining small plates of proper orientation suitable for the problem. Although the specimens were small the technique of measurement produced results of relatively good precision, as evidenced by the numerous cross checks obtained. Best values of the moduli and the estimated probable errors are given. The elastic stiffness moduli in units of 10^{12} dynes/cm^2 are as follows:

$$c_{11} = 2.147 \pm 0.14\%, \quad c_{12} = 0.465 \pm 0.6\%,$$
$$c_{13} = 0.218 \pm 1.5\%, \quad c_{22} = 1.986 \pm 0.14\%,$$
$$c_{23} = 1.076 \pm 0.34\%, \quad c_{33} = 2.671 \pm 0.14\%,$$
$$c_{44} = 1.2444 \pm 0.10\%, \quad c_{55} = 0.7342 \pm 0.10\%,$$
$$c_{66} = 0.7433 \pm 0.10\%.$$

539.32

4073. ELASTIC CONSTANT—INTERNAL FRICTION SPECTROMETER. D.O.Thompson and F.M.Glass.
Rev. sci. Instrum., Vol. 29, No. 11, 1034-40 (Nov., 1958).

The instrument described has proved to be very useful in measurements which must last over extended periods of time as well as in measurements which require a high degree of resolution. The essential feature of the spectrometer is the fact that it holds the sample in oscillation at its resonance frequency and at a preset strain amplitude, and measures the internal friction of the sample through a measurement of the driving force necessary to maintain the preset amplitude. The instrument was developed in the course of measurements of radiation-induced changes in the Young's moduus and internal friction of metal single crystals.

539.32

4074. THE DETERMINATION OF THE ELASTIC CONSTANTS OF CUBIC CRYSTALS BY THE ULTRASONIC ELASTOGRAM METHOD.
L.Bergmann.
Z. Naturforsch., Vol. 12a, No. 3, 229-33 (1957). In German.

The elastic constants of RbCl, RbBr, KCl, KBr, KI, NaCl, NaBr, NaI, LiF, CaF_2, BaF_2 have been determined by the Schaefer—Bergmann method, which involves the diffraction of light by the crystal vibrating at ultrasonic frequencies. The apparatus is described; the form of the diffraction figures (elastograms) and the equations for deriving the elastic constants from them are discussed.

R.F.S.Hearmon

539.32

4075. THE ELASTIC CONSTANTS OF ALKALI HALIDES OF THE ROCK-SALT TYPE. K.Spangenberg and S.Haussühl.
Z. Krist., Vol. 109, No. 4-6, 422-37 (1957). In German.

The single crystal elastic constants of the 16 alkali halides XY, where X is Li, Na, K or Rb and Y is F, Cl, Br or I have been measured by the Schaefer—Bergmann method using an improved technique (see preceding abstract).

R.F.S.Hearmon

539.41

4076. THE RADIAL COMPRESSIVE FORCE OF RUBBER PACKING RINGS AT REDUCED TEMPERATURES.
Yu.A.Nosov and S.B.Ratner.
Zh. tekh. Fiz., Vol. 28, No. 7, 1448-51 (1958). In Russian.

The variation of the contact force between rubber packing rings and a metal surface at low temperatures is studied. Below a certain temperature, there is practically a linear fall of the contact force with temperature reduction, the rate depending upon the initial compressive force. The effect of the cross-section of the packing ring, i.e. square, circular or U-shaped, is discussed, and it is shown that the U shape, which permits bending stresses, gives less reduction of the contact force at low temperatures than the others.

P.G.Morgan

539.42

4077. THE CONNECTION BETWEEN THE DURABILITY (i.e. TIME TO RUPTURE) AND CREEP OF METALS AND ALLOYS.
S.N.Zhurkov and T.P.Sanfirova.
Zh. tekh. Fiz., Vol. 28, No. 8, 1719-26 (1958). In Russian.

Measurements were made at various stresses, σ, and temperatures, T, (373°-773°K) of the times to rupture, τ, and rates of strain prior to rupture during quasi-viscous creep, v, of annealed specimens cut from sheets of Al, Pt, Ni, Al + 4.6% Zn, Al + 10% Zn, Al + 2% Mg, and Ni + 0.8% Co. The measurements were made at constant stress; for a given stress and temperature the extreme values of τ (or v) measured differed by up to nine powers of ten. With the exception of Al and its alloys at high T and low σ, it was found that $\tau = \tau_0 \times \exp[(U - \gamma\sigma)/kT]$ and $v = v_0 \times \exp[(\gamma\sigma - U)/kT]$, where τ_0, v_0, γ and U are constants for a given material and k is Boltzmann's constant; U was close to the sublimation energy for the pure metals and differed from the activation energy for self-diffusion. Thus $\tau \times v$ is independent of σ and T. The distributions of τ and v values for 80 Al specimens deformed under 6.5 kg/mm^2 stress at 290°K are also plotted; the two distributions are the same shape and for a logarithmic τ (or v) axis look nearly Gaussian. No fundamental interpretation of any of the results was attempted.

K.F.Hulme

539.431

4078. ON THE FATIGUE LIMIT OF METALS. P.Feltham.
Phil. Mag. (Eighth Ser.), Vol. 3, 806-10 (Aug., 1958).

To check whether a close relation exists between the fatigue limit, s_f, in tension-compression and the critical tensile stress, s_c, below which slip bands do not form and coarsen in face-centred cubic metals, an examination was made of existing experimental data and theories to see if the ratio s_f/s_c were independent of temperature, which should occur if s_f were equal or proportional to s_c. The data presented show that the hypothesis of the temperature independence of the stress ratio seems plausible but further data are needed to substantiate it fully. The similarity of the temperature dependence of the fatigue limit of face centred cubic and hexagonal metals is thought to suggest that in the hexagonal metals some form of thermally activated non-basal slip, i.e. cross-slip, may be the pre-requisite for the formation of fatigue cracks.

A.C.Whiffin

539.433 : 534.372

ATTENUATION OF SMALL AMPLITUDE STRESS WAVES IN SOLIDS. See Abstr. 3236

539.434

4079. PLASTIC CREEP OF GERMANIUM SINGLE CRYSTALS.
H.G.van Bueren.
Physica, Vol. 24, No. 10, 831-7 (Oct., 1958).

The temperature and stress dependence of the creep rate of germanium single crystals, loaded in tension, were measured. Three parts are distinguished in the creep curve. A theory is presented in which the initial part is explained in terms of the liberation of dislocation sources from impurity atoms, whereas the stationary creep rate attained in the second part is determined by the mobility of the dislocations themselves. This mobility is restricted owing to the occurrence of broken valence bonds along the dislocations. The third, work-hardening part of the creep curve is reached when the dislocation density in the material has reached a sufficient magnitude for piled-up groups to form.

539.501

4080. ON THE PHYSICAL INTERPRETATION OF THE WEISSENBERG EFFECT. P.A.d'Auriac and H.Gérodolle.
C.R. Acad. Sci. (Paris), Vol. 247, No. 25, 2295-6 (Dec. 22, 1958).
In French.

The Weissenberg climbing effect can be demonstrated under certain conditions in simple suspensions of elastic solid particles in Newtonian liquids. The phenomenon becomes more marked with increasing liquid viscosity, with increasing fineness of division of the solid, and with increasing solid concentration.

J.G.Oldroyd

539.87

4081. EROSION DAMAGE TO SOLIDS CAUSED BY HIGH-SPEED COLLISION WITH RAIN. O.G.Engel.
J. Res. Nat. Bur. Stand., Vol. 61, No. 1, 47-52 (July, 1958).

The stresses that are produced when a liquid drop collides with the planar surface of a solid are discussed. These are a result of the impact pressure and the consequent radial flow of the drop. It is concluded that a rain-erosion resistant material may be either soft and rubbery or hard and rigid. If it is soft and rubbery it mitigates the applied stresses but it must be able to withstand the mitigated stresses. If it is hard and rigid it does not mitigate the applied stresses and it must be able to withstand the unmitigated stresses. Materials investigated include teflon, selectron, neoprene and methyl methacrylate.

539.893

4082. EXPLOSIVE PRESS FOR USE IN IMPULSIVE LOADING STUDIES. E.W.LaRocca and J.Pearson.
Rev. sci. Instrum., Vol. 29, No. 10, 848-51 (Oct., 1958).

Small explosively activated presses have been used as research tools in the study of the behaviour of powdered materials under impulsive loads. Both single- and double-acting presses have provided positive retention of the test specimen. The double-acting press, which is of a sandwich-type construction, uses two explosive charge fired simultaneously to drive two opposed pistons together into a central steel cylinder in which the specimen material has been placed. Estimates of the pressures which can be obtained are of the order of several million pounds per square in. By modifying the working faces of the pistons, materials can be formed into specimens of various shapes by the press action. Operation of these presses and their application to the study of several materials are described.

PHYSICAL CHEMISTRY

PHASE EQUILIBRIUM

CHEMICAL REACTIONS

541.122

4083. THE FERRATE EQUILIBRIUM IN ALKALI HYDROXIDE MELTS. H.Lux and T.Niedermaier.
Z. Naturforsch., Vol. 11a, No. 9, 762 (1956). In German.

By means of the method for taking extinction measurements in non-transparent apparatus [cf. Lux and Niedermaier, Zeitschrift für anorganische und allgemeine Chemie, Vol. 285, 246 (1956)], it has been found, that in alkali hydroxide ferrate melts at 300-500° C under known partial pressures of oxygen and aqueous vapour, the red violet ferrate (VI) is completely stable in KOH melts under oxygen at 310°; low oxygen or high aqueous vapour pressure promote the formation of a yellow brown ferrate (III) and a colourless ferrate (III) whose equilibrium is highly temperature dependent. Deep brown solutions of Fe_2O_3 in NaOH melts are found to contain the iron in a higher state of oxidation than the trivalent form hitherto accepted. H.H.Hodgson

541.126

4084. STANDARD ENTHALPY AND FREE ENERGY OF FORMATION OF DIIMIDE. P.Smith.
J. chem. Phys., Vol. 29, No. 3, 683-4 (Sept., 1958).

An experimental estimate for the standard change of enthalpy during the formation of diimide from hydrazine is 26 ± 5 kcal mole^{-1}. This compares to an interpolated value of $\Delta H_{25^\circ} = 32.6 \pm 5$ kcal mole^{-1} from data on the gas-phase reactions of the isoelectronic molecules C_2H_6 and H_2O_2, in turn, relying on the observation that ΔH, or ΔF, varies linearly, to within ±5 kcal mole^{-1}, with change in atomic number of the non-hydrogen atom in the isoelectronic molecules. R.Schnurmann

541.127 : 548.524

4085. PASSIVITY DURING THE OXIDATION OF SILICON AT ELEVATED TEMPERATURES. C.Wagner.
J. appl. Phys., Vol. 29, No. 9, 1295-7 (Sept., 1958).

The dependence of the rate of the oxidation of silicon in oxygen—helium mixtures on gas composition at 1410° C is discussed theoretically. At low oxygen contents of the gas, no layer of solid silica is expected to occur and the rate of attack due to formation of volatile SiO is supposed to be proportional to the oxygen partial pressure in the bulk gas. Above a critical oxygen partial pressure, solid silica may be formed and the rate of attack under steady-state conditions may drop by several powers of ten.

541.127

4086. RELATIVE RATES OF REACTIONS OF OXYGEN ATOMS WITH OLEFINS. R.J.Cvetanović.
J. chem. Phys., Vol. 30, No. 1, 19-26 (Jan., 1959).

Relative rates of addition of oxygen atoms in their ground electronic state to a number of olefines in the gas phase were determined at room temperature. These reactions exhibit the following regularities: (1) systematic variation of the rates with the structure of the olefines; (2) specificity with respect to the position of addition of oxygen atoms; and (3) partial molecular rearrangement of the addition products according to definite rules. The observed structural effects and some close analogies with certain olefine addition reactions in solution are discussed in the light of electronic theories of organic chemical reactions. A comparison is made of the absolute values of the rate constants of the reactions of oxygen atoms with olefines, derived from various sources.

541.127 : 534.222.2

4087. LIMITATIONS OF THE REFLECTED SHOCK TECHNIQUE FOR STUDYING FAST CHEMICAL REACTIONS AND ITS APPLICATION TO THE OBSERVATION OF RELAXATION IN NITROGEN AND OXYGEN. R.A.Strehlow and A.Cohen.
J. chem. Phys., Vol. 30, No. 1, 257-65 (Jan., 1959).

Strip film and multiple spark schlieren pictures of reflected shocks were taken in the gases He, A, N_2, O_2, H_2, NO, CO_2, N_2O, CH_4, and C_3H_8. Interaction of the reflected shock with the boundary layer behind the incident shock was observed in all gases except He and A. The bifurcation and acceleration associated with the interaction limits the use of the reflected shock region for high-temperature kinetic and equilibrium studies. It was possible to minimize the effects of this interaction by using gases with high γ and confining measurements to a region near the back wall. Reflected shock observations agreed with Mark's theory of the development of bifurcation but disagreed with his predicted deceleration of the reflected shock. From comparison of incident and reflected shock velocities, measured at the back wall, with ideal one-dimensional theory, it was concluded that calculations of the temperature behind the reflected shock from incident shock velocities would yield high results. Decelerations of the reflected shock in N_2 and O_2 were observed in the strip films and were related to the vibrational relaxation behind the reflected shock. Measurements of relaxation times from the film yielded values which are in good agreement with Blackman's data. These experiments indicate that changes in reflected shock velocity can be used to observe the overall reaction rates of fast chemical reactions.

541.127

4088. THEORY OF DETONATIONS. III. IGNITION TEMPERATURE APPROXIMATION.
C.F.Curtiss, J.O.Hirschfelder and M.P.Barnett.
J. chem. Phys., Vol. 30, No. 2, 470-92 (Feb., 1959).

For Pt II, see Abstr. 7585 (1958). In order to discuss in more detail the topological nature of the solutions and the nature of the detonation limits, the equations are simplified by idealizing the chemical kinetics in the following manner: at temperatures below an ignition temperature, the reaction rates are taken to be zero; at temperatures above this ignition temperature, the reaction rates are taken to be functions of the chemical composition but independent of the temperature. In order to further simplify the equations, the Prandtl number is taken to be $\frac{3}{4}$ and the Lewis number to be unity. These idealizations lead to an uncoupling of the detonation equations, although the importance of the transport properties remains unchanged. In the high-temperature range, the fractions of the mass rate of flow, G_i, are functions of the chemical composition only. In the low-temperature range, the G_i are constant. With these simplifications, we consider in detail both flames and detonations involving the unimolecular $A \rightarrow B$ or the equivalent bimolecular reaction $A + X \rightarrow B + X$ where X represents either a molecule of A or B. Calculations are made for values of the ignition temperature greater than, equal to, and less than the von Neumann spike temperature. Comparison of these calculations with numerical calculations previously performed, using an Arrhenius type variation of the reaction rate with temperature, give the best agreement when the ignition temperature is taken to be greater than the von Neumann spike temperature. If the ignition temperature is greater than the von Neumann spike temperature, it is found that the thickness of the detonation wave is of the order of one mean free path. This suggests the conclusion that under the extreme conditions of a detonation the usual concept of chemical equilibrium between activated state and reactant molecules cannot apply. Instead, the molecules gain their energies of activation in successive stages. With this more complicated reaction mechanism, the detonation wave would be much thicker. These conclusions, regardless of the functional form of the rate law, depend upon the existence of a lower limit for the value of the rate constant which can support a steady state detonation. Such a lower limit was suggested by our previous calculations with the Arrhenius rate law. However, more detailed studies are required to determine under what conditions such a lower limit may exist.

ELECTROCHEMISTRY

541.135

4089. ELUCIDATION OF THE HALF-CELL REACTIONS IN THE SYSTEM IRON/AQUEOUS SOLUTION BY MEANS OF INTERMITTANT CHARGE CURVES. E.Lange and H.Weidinger.
Naturwissenschaften, Vol. 45, No. 16, 383-4 (1958). In German.

In the pH range 2.3 to 13 a reversible electrode potential sets in corresponding to an electrode (Fe/Fe_3O_4) with the half-cell reaction

$$3\ Fe^{+8/3} + 4H_2O \rightarrow Fe_3O_4 + 8\ H^+.$$

In the current pauses during (cathodic or anodic) intermittent charging the same reversible electrode potential is found at first. This is followed later by a new constant potential which in the alkaline region corresponds with the half-cell reaction

$$2\ Fe_3O_4 + 2OH^- \rightarrow 3\,\alpha - Fe_2O_3 + H_2O + 2\,e$$

and in the acid region with

$$2\ Fe_3O_4 + H_2O \rightarrow 3\,\gamma - Fe_2O_3 + 2H^+ + 2\,e.$$

A further constant potential suggests perhaps the formation of a still higher oxidation state thus

$$Fe_2O_3 + 3H_2O \rightarrow 2FeO_3 + 6H^+ + 6\,e.$$

W.Good

PHOTOCHEMISTRY
RADIATION CHEMISTRY

541.14

4090. ELECTRON SPIN RESONANCE STUDIES OF PHOTOCHROMIC SOLIDS. H.S.Gutowsky, R.L.Rutledge and I.M.Hunsberger.
J. chem. Phys., Vol. 29, No. 5, 1183-4 (Nov., 1958).

Of several photochromic solids, coloured by exposure to sunlight or a mercury vapour lamp, only N-(3-pyridyl) sydnone exhibited an electron spin resonance. This was not detected immediately after irradiation, but appeared subsequently at a rate dependent upon the temperature and the presence of air; it did not appear in vacuo. These results and possible interpretations are discussed.

J.M.Baker

541.15

4091. EFFECTS OF GAMMA RADIATION ON ORGANIC FLUIDS AND LUBRICANTS. W.L.R.Rice.
Nucleonics, Vol. 16, No. 10, 112-13 (Oct., 1958).

The changes in viscosity, flash point, gas evolution and evaporation of petroleum oil, a synthetic oil, a silicate ester, kerosene and monoisopropyl-biphenyl for gamma doses up to 10^{12} ergs/g of carbon were measured using spent fuel elements as a source.

R.D.Smith

541.15 : 539.12

ALPHA-PARTICLE IRRADIATION APPARATUS.
See Abstr. 3802

DISPERSIONS . COLLOIDS . ADSORPTION

541.183

4092. ADSORPTION OF OXYGEN ON SILICON.
J.Eisinger and J.T.Law.
J. chem. Phys., Vol. 30, No. 2, 410-12 (Feb., 1959).

The sticking probability of oxygen on silicon was measured as a function of coverage. At room temperature it has a maximum value between 0.01 and 0.02 for low coverage and decreases approximately exponentially as the coverage increases.

541.183

4093. ADSORPTION OF OXYGEN ON TUNGSTEN. J.Eisinger.
J. chem. Phys., Vol. 30, No. 2, 412-16 (Feb., 1959).

The adsorption of oxygen on a single crystal tungsten ribbon at room temperature was studied. The maximum coverage was found to be 12.3×10^{14} atoms cm^{-2} and the initial sticking probability is 0.24 approximately. The rate of formation of tungsten oxide at the surface of the hot filament was also studied. These results and earlier ones bearing on the adsorption of nitrogen on tungsten are discussed in the light of an idealized atomic model for the tungsten surface.

541.183

4094. INTERACTION OF RARE GASES WITH METAL SURFACES.
I. A, Kr, AND Xe ON TUNGSTEN. G.Ehrlich and F.G.Hudda.
J. chem. Phys., Vol. 30, No. 2, 493-512 (Feb., 1959).

These interactions were examined in the field emission microscope. Bombardment by rare gas ions results in a penetration of the lattice and an apparent diminution of the work function; bombardment damage is partly annealed between 79° and 300°K. Adsorption lowers the work function by 1.38 eV for Xe, on saturation at 79°K, 1.18 eV for Kr at 20°K, and 0.87 eV for A at the same temperature. The work function diminishes monotonically with Xe coverage even after more than a single layer is formed. Binding to the surface is structure sensitive — it is strongest around the 100 pole, in the vicinity of the 116 and 130 planes, and weakest at the 111. This sequence of binding energies corresponds to that calculated for different lattice sites on the assumption of dispersion forces. The lowering of the work function caused by adsorption is interpreted as a polarization of the gas atoms by the dipole layer of the metal surface; formally, the interactions at a metal resemble those of the rare gases adsorbed on ionic crystals. Interaction of polarized adatoms and the antiparallel field applied for electron emission increases the free energy of the adlayer, bringing about rearrangements particularly important for adsorbed argon. Observations of changes in emission with temperature yield a heat of desorption of 8 kcal/mole for Xe, as well as the following values for the activation energy for surface diffusion: Xe over the (310), toward the (100), $E_D = 3.8$ kcal/mole, over the (111). $1.5 < E_D < 3.4$ kcal/mole; for the diffusion of Kr and A over the (310) toward the (100), $E_D > 1.1$ kcal/mole and $E_D < 0.9$ kcal/ mole, respectively.

541.183.26

4095. CHEMISORPTION OF NITROGEN ON TUNGSTEN.
P.Kisliuk.
J. chem. Phys., Vol. 30, No. 1, 174-81 (Jan., 1959).

The amount of nitrogen chemisorbed on a polycrystalline tungsten ribbon was measured as a function of the temperature of the ribbon and the pressure in the region of less than one monolayer. By assuming the condensation coefficient to be insensitive to the temperature of the gas, values of the thermodynamic functions are determined. It is found that N_2 is adsorbed on tungsten as atoms with a heat of adsorption of 5.0 eV per molecule (± 10%) independent of coverage over the experimental range of coverage. In the temperature range 1150-1670°K the differential entropy of adsorption is of the order expected for adsorption on localized sites, with a moderate contribution from the vibrational degrees of freedom.

CHEMICAL ANALYSIS

545.1 : 531.753

GAS CIRCULATING APPARATUS CONTAINING A MAGNETIC BALANCE. See Abstr. 3177

545.844 : 536.

4096. EFFECT OF THE CARRIER GAS ON THE SENSITIVITY A THERMAL CONDUCTIVITY DETECTOR IN GAS CHROMATOGRAPHY. N.H.Ray.
Nature (London), Vol. 182, 1663 (Dec. 13, 1958).

It is shown that the carrier gas with lowest thermal conductiv will give the highest sensitivity, and that of the commoner inorgan gases carbon dioxide and argon are likely to give best results.

W.Goc

CRYSTALLOGRAPHY

548.232.2

4097. ON A LAMELLAR STRUCTURE IN CdS CRYSTALS. H.Radelt.
Naturwissenschaften, Vol. 45, No. 19, 463 (1958). In German.

Describes optical observations on crystals grown from vapour, and the effect of the lamellar structure on fluorescence under u.v. light.

A.R.Stokes

548.33 : 548.6

4098. POLY- AND PSEUDOMORPHISM IN THIN CRYSTAL LAYERS GROWN FROM THE VAPOUR PHASE. H.Lüdemann.
Z. Naturforsch., Vol. 12a, No. 3, 226-8 (1957). In German.

Electron diffraction studies show that TlCl and CsCl crystals grown from the vapour phase on an NaCl cleavage plane as substrate begin their growth with the NaCl lattice type. For a growth rate of a few A/sec the NaCl lattice type persisted up to a thickness of about 1000 A, whereas for a growth rate of 10-100 A/sec the lattice type changed to that of CsCl for crystals grown to a thickness of more than 10-100 A. The NaCl lattice type of CsCl crystals grown on an NaCl cleavage plane could be changed to the CsCl lattice type by tempering the crystals below 100° C, but then the crystal orientation was different from that of quickly grown crystals of the CsCl type.

R.Schnurmann

548.52 : 537.311.33

4099. PREVENTING CONDUCTIVITY FLUCTUATIONS DURING GROWTH OF A SEMICONDUCTING CRYSTAL.
W.G.Pfann, J.N.Hobstetter and G.S.Indig.
J. appl. Phys., Vol. 29, No. 8, 1238-40 (Aug., 1958).

Fluctuations in the electrical conductivity of an extrinsic semiconductor arising from fluctuations in the growth conditions of the crystal can be eliminated by adding to the melt a critical concentration of a suitable donor or acceptor. Useful solute combinations are those for which one of the two characteristics: (a) the conductivity type and (b) the sign of $(1 - k)$, where k is the distribution coefficient, must be opposite and the other the same for the two solutes. The critical ratio of melt concentrations, (C_2/C_1), is equal to $(dk_1/df)/(dk_2/df)$, where f denotes growth rate, and subscript 1 denotes the major solute. Expressions are derived for the critical ratio, for the effects of deviations from it and for the optimum characteristics of solute combinations.

548.52 : 537.311.33

4100. FLOATING CRUCIBLE TECHNIQUE FOR GROWING UNIFORMLY DOPED CRYSTALS. W.F.Leverton.
J. appl. Phys., Vol. 29, No. 8, 1241-4 (Aug., 1958).

The floating crucible method for growing single crystals is described. This method, a simple modification of the Czochralski technique, permits the growing of large germanium single crystals of uniform resistivity. By growing the crystal from an inner crucible floating in the germanium melt, the condition of constant liquid volume in the inner crucible is achieved and the concentration gradient characteristic of crystals grown by the Czochralski method is eliminated. Earlier determinations of the distribution coefficients of some doping impurities in germanium have been verified. The density of liquid germanium at the melting point was determined to be 5.94 ± 0.06 g/cm^3. The use of the floating crucible technique for the growing of uniform silicon crystals is discussed.

548.522 : 541.127

4101. PRODUCTION OF CADMIUM SULFIDE CRYSTALS BY COEVAPORATION IN A VACUUM. R.J.Miller and C.H.Bachman.
J. appl. Phys., Vol. 29, No. 9, 1277-85 (Sept., 1958).

Apparatus was developed by which beams of cadmium and of sulphur were simultaneously directed to a common point on a temperature controlled substrate in a demountable vacuum apparatus. Cadmium sulphide crystals were obtained. The various types of crystals: spiroidals, globules, ribbons, and needles are described together with the conditions tending to produce each type. Crystal size can be increased by repeated exposure to the beams.

548.523 : 537.312.

4102. HIGH-PRESSURE, HIGH-TEMPERATURE GROWTH OF CADMIUM SULFIDE CRYSTALS. W.E.Medcalf and R.H.Fahrig.
J. Electrochem. Soc., Vol. 105, No. 12, 719-23 (Dec., 1958).

A process is described for growing crystals of uniform size, shape, and homogeneity from the melt. Structure and electrical characteristics of the crystals are discussed, and segregation data on several impurity species are given. A method is described for preparing high purity cadmium sulphide powder by the purification cadmium and sulphur followed by direct combination of the elements

548.524 : 537.311.3

4103. FACTORS DETERMINING THE OXYGEN CONTENT OF LIQUID SILICON AT ITS MELTING POINT.
W.Kaiser and J.Breslin.
J. appl. Phys., Vol. 29, 1292-4 (Sept., 1958).

Earlier investigations have shown that silicon crystals can contain considerable amounts of oxygen. Oxygen can influence the sem conductor properties of silicon considerably and,therefore, it is of interest to study the factors which determine the oxygen content of liquid silicon at its melting point. The oxygen content of liquid was found to increase proportionally to the oxygen content of the ambien helium–oxygen mixture for oxygen partial pressures $p(O_2) < 8$ mm Hg. This observation is explained by the proportionality between the oxygen partial pressure $p(O_2)$ in the ambient gas and the SiO partial pressure on the surface of liquid silicon. For $p(O_2) > 8$ mm H the silicon melt is covered by a film of silica and a saturation value of about 2×10^{18} oxygen atoms per cm^3 is observed in the crystallized sample.

548.53 : 536.424.1

4104. ON THE QUALITY OF GRAY TIN CRYSTALS AND THEIR RATE OF GROWTH. J.H.Becker.
J. appl. Phys., Vol. 29, No. 7, 1110-21 (July, 1958).

Various methods of preparing samples of gray tin suitable for electrical and optical investigations are described. Attempts to deposit atoms of tin directly into the gray tin lattice by vapour and electrodeposition and by chemical reactions at low temperatures have all yielded crystals of white tin; however, by transformation of white tin under suitable conditions it is possible to obtain large coherent crystals of gray tin. These include samples several cm long showing single crystal regions up to 2 mm, as well as flat thin films as large as 25 × 25 mm^2. The temperature at which the transformation takes place, the purity of the initial white tin specimen, its size, and the method of attaching a sample to a substrate are important factors for determining both the quality and the rate of transformation. Investigations were carried out over a wide range of temperatures for several sources of high purity tin, as well as with additions of In, Ga, Al, As, and Sb. Effects of mechanical and thermal treatment are also included. A careful distinction is made between the time for nucleation and the rate of growth after nucleation. Results are analysed in the light of absolute rate theory and a reasonable explanation is obtained for many of the observed phenomena. The heat of activation for the white-to-gray tin reaction is determined as $(8.7 \pm 1.5) \times 10^3$ cal/mole at 0° K.

548.55 : 537.312.5

4105. PREPARATION OF THIN ANTHRACENE SINGLE CRYSTALS. H.Kallmann and M.Pope.
Rev. sci. Instrum., Vol. 29, No. 11, 993-4 (Nov., 1958).

Anthracene single crystals ranging in thickness from 4 to 80 μ and from 0.5 to 2 cm^2 in area were prepared by crystallization from a selected solution system. The method is general and employs a density and temperature gradient within the solution which permits the crystal to grow while suspended in the solvent. These anthracene crystals were used in optical and electrical studies, particularly in photoconductivity measurements. For example, a 10 μ crystal under high-intensity flash excitation passed a current of 10 mA/cm^2 at 50 V; a 33 μ crystal under steady illumination passed a current of 30 $\mu A/cm^2$ at 80 V. These crystals exhibited a strong rectifying action, being about 50 times more conductive when the positive electrode was illuminated.

548.57 : 539.27

A NEW TECHNIQUE FOR DECORATION OF CLEAVAGE AND SLIP STEPS ON IONIC CRYSTAL SURFACES. See Abstr. 4071

X-RAY CRYSTALLOGRAPHY

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also the Section entitled "STRUCTURE OF SOLIDS".

548.73

4106. CRYSTAL STRUCTURE AND INFORMATION THEORY.
D.McLachlan, Jr.
Proc. Nat. Acad. Sci. U.S.A., Vol. 44, No. 9, 948-56 (Sept., 1958).

It is concluded that the amount of information obtainable from X-ray data is usually sufficient to determine a structure even if phases are not known. If the electron density is known at one or more points in the unit cell then certain combinations of phases can be excluded. A.R.Stokes

548.73 : 539.2

4107. THE INVESTIGATION OF DISLOCATION DENSITY AND DISLOCATION ARRANGEMENT IN PLASTICALLY DEFORMED CRYSTALS BY MEANS OF LOW-ANGLE X-RAY SCATTERING.
A.Seeger.
Z. Naturforsch., Vol. 11a, No. 9, 724-30 (1956). In German.

Low-angle scattering of X-rays is considered from the point of view of density variations in the material. The scattering is worked out for a dislocation consisting of two "half-dislocations". A.R.Stokes

548.732 : 539.2

APPROXIMATE ELASTIC SPECTRUM OF β-AuZn FROM TEMPERATURE DIFFUSE SCATTERING OF X-RAYS. See Abstr. 4005

548.733

4108. DESCRIPTION OF A LOW-TEMPERATURE X-RAY CAMERA. M.Dietze.
Exper. Tech. der Phys., Vol. 6, No. 3, 120-4 (1958). In German.

The camera, which can be used at temperature of $-100^\circ C$ (± 3-$6^\circ C$), and pressures of 1×10^{-2} to 5×10^{-3} Torr, is described and its essential features discussed. It has been used to study the mixed polymerization of butadienstyrene. J.R.Mallard

548.733 : 536.581.3

4109. A LIQUID-HELIUM COLD CELL FOR USE WITH AN X-RAY DIFFRACTOMETER.
I.A.Black, L.H.Bolz, F.P.Brooks, F.A.Mauer and H.S.Peiser.
J. Res. Nat. Bur. Stand., Vol. 61, No. 5, 367-71 (Nov., 1958).

A liquid-helium cold cell for use with the General Electric X-ray goniometer was designed and constructed. It is used to obtain X-ray diffraction patterns of polycrystalline solids deposited from the gaseous phase on a helium-cooled surface. This work is part of the programme for studying the stabilization of free radicals.

548.733

4110. AN IMPROVED FRAME CAMERA [RAHMENKAMMER] FOR X-RAY LOW-ANGLE SCATTERING.
J.Henke and G.E.R.Schulze.
Z. Naturforsch., Vol. 12a, No. 4, 346 (1957). In German.

Describes modifications to Kratky's camera (Abstr. 7870/1954), whereby an increase in intensity of the beam is obtained. A.R.Stokes

548.735

4111. EFFECT OF LORENTZ FACTOR AND DISPERSION ON MEASUREMENT OF LATTICE PARAMETERS WITH POWDER CAMERAS. E.R.Pike and A.J.C.Wilson.
Proc. Phys. Soc., Vol. 72, Pt 5, 908-10 (Nov. 1958).

The effect of Lorentz factor and dispersion on line profile is considered. It is found that the line peak is not affected but the centre of gravity of the line is shifted. An extrapolation procedure is suggested which can be applied when centres of gravity are measured. The error involved is about 1 part in 10^4. A.E.I. Research Laboratory

548.735.4

4112. CONCERNING INDIUM PHOSPHIDE OF STOICHIOMETRIC AND NON-STOICHIOMETRIC COMPOSITIONS.
N.A.Goryunova, N.N.Fedorova and V.I.Sokolova.
Zh. tekh. Fiz., Vol. 28, No. 8, 1672-5 (1958). In Russian.

Precision X-ray measurements gave the same lattice parameter ($a = 5.8693 \pm 0.0006$ A at $25^\circ C$) for stoichiometric InP and for InP prepared with excess of In or P, which suggests a very small range of homogeneity for this phase. The micro-hardness of InP was found to be 410-430 kg/mm^2. C.H.L.Goodman

548.736.1

4113. THE DIFFRACTION OF X-RAYS BY DIAMOND. II.
C.V.Raman.
Proc. Indian Acad. Sci. A, Vol. 47, No. 6, 335-43 (June, 1958).

For Pt I, see Abstr. 8522 (1958). Pt II deals with the hypothesis of dextro- and laevo-carbon atoms; classification of diamonds; the vibration spectrum of diamond; the geometry of dynamic X-ray reflections. A.R.Stokes

548.736.1

4114. THE DIFFRACTION OF X-RAYS BY DIAMOND. III.
C.V.Raman.
Proc. Indian Acad. Sci. A, Vol. 48, No. 1, 1-8 (July, 1958).

For Pt II, see preceding abstract. Pt III deals with correlation between infrared absorption, absence of birefringence, crystal perfection, presence of dynamic reflection of X-rays, and tetrahedral symmetry. A.R.Stokes

548.736.4 : 538.221

4115. X-RAY DIFFRACTION AND MAGNETIC MEASUREMENTS OF THE Fe—Cr SPINELS. W.D.Derbyshire and H.J.Yearian.
Phys. Rev., Vol. 112, No. 5, 1603-7 (Dec. 1, 1958).

X-ray diffraction intensity measurements and magnetic moment measurements were made on the spinel system $FeFe_{2-x}Cr_xO_4$, $0 \leq x \leq 2$, for the purpose of finding structural details in this system which were unknown. The X-ray measurements covered the entire composition range, and the magnetic measurements covered the range from $x = 0$ to $x = 1.2$. From the X-ray measurements the oxygen parameter of each sample was deduced. These parameters indicated inverse spinels for low values of x, partially inverse spinels for intermediate values of x, and normal spinels for $x = 1.3$ to $x = 2$. The magnetic measurements indicated inverse spinels for $x = 0$ to $x = 0.3$. It was inferred from the magnetic measurements that the spins of cations on the B sites are not all parallel, at least for large x and probably for $x > 0.5$. Hence, the arrangement of cations on the A and B sites for a spinel in this composition range could not be deduced from its saturation magnetic moment. Estimates of the relative strengths of the magnetic interactions in various composition ranges and a prediction of the variation in saturation magnetic moment with composition in the range $x = 1.3$ to $x = 2$ were made.

548.736.5 : 538.221

CRYSTAL STRUCTURE AND FERRIMAGNETISM IN $NiMnO_3$ AND $CoMnO_3$. See Abstr. 3640

548.74

4116. GOLD–MANGANESE ALLOYS; SOME PRELIMINARY STUDIES BY NEUTRON DIFFRACTION. G.E.Bacon and R.Street.
Proc. Phys. Soc., Vol. 72, Pt 3, 470-4 (Sept., 1958).

A preliminary account of the results of a neutron diffraction investigation of the Au–Mn system, including a detailed study in the neighbourhood of the composition AuMn where the crystal structure is tetragonal with c/a only slightly different from unity. The diffraction pattern contains lines, magnetic in origin, which do not appear in X-ray diffraction patterns. The magnetic properties of the alloys are discussed, in relation to their structure. M.R.Hopkins

548.74 : 539.2 : 538.114

FIELD DEPENDENCE OF NEUTRON SCATTERING BY SPIN WAVES. See Abstr. 3628

548.74

4117. ON THE MEASUREMENT OF FOURIER COEFFICIENTS FROM THE DYNAMICAL ELECTRON DIFFRACTION EFFECTS IN THIN SINGLE CRYSTALS. S.Haussühl.
Z. Naturforsch., Vol. 11a, No. 12, 1036-7 (1956). In German.

The interference was studied between the primary electron wav and the secondary wave scattered by thin single crystals. The crystals examined were CdI_2, $CdBr_2$, $HgBr_2$, MoS_2, $NaCrS_2$ and PbI_2. It was concluded that the approximate two-beam formula of the dynami theory could be used to determine accurately the Fourier coefficient and the crystal thickness in the range of thickness 350-1000 A and in the voltage range 35-85 kV. B.T.M.Willis

548.74 : 537.228 : 539.234

AN ELECTRON DIFFRACTION INVESTIGATION OF EFFECT OF ELECTRIC FIELD ON THE STRUCTURE OF THIN FILMS OF DIPOLAR LONG-CHAIN MOLECULES. See Abstr. 4063

GEOPHYSICS

550.341

4118. NEW CRITERIA FOR REFRACTIVE SEISMIC PROSPECTING. C.Contini, C.Maino and M.Ranucci.
Ann. Geofis., Vol. 11, No. 1, 15-54 (Jan., 1958). In Italian.

Outlines the theory of a method for determination of the direction of the boundary between two geological strata, by measuring the time taken for the shock wave of an explosion to reach three separate receiving stations; the method is generalized to cover the case of several boundaries. A nomogram is given for $V_1/V_2 = \sin i$ and $\tan i$. Details are given of a method of computation leading to determination of the angle of emergence of the wave, hence to results not given by other methods. It is claimed that the method given is more rapid than previous methods. No field trial results are quoted. N.Corcoran

550.384.4

4119. THE DIURNAL VARIATION OF IRREGULAR GEOMAGNETIC FLUCTUATIONS. II. S.B.Nicholson and C.R.Wulf.
J. geophys. Res., Vol. 63, No. 4, 803-6 (Dec., 1958).

For previous part see J. geophys. Res., Vol. 60, No. 4, 389-94 (Dec., 1955). Using the eight daily K numbers (three-hour-range indices) for six observatories in moderately low latitudes and fairly well distributed in longitude, a universal-time component of the daily variation of irregular geomagnetic fluctuations having an apparently significant amplitude in the yearly average has been found in the data for the nine years 1940-1948. It is suggested that a portion of magnetic disturbance may be produced by dynamo action in the ionosphere, and give rise to this yearly-average universal-time component.

550.385

4120. TIME CONSTANTS IN THE GEOMAGNETIC STORM EFFECT. C.O.Hines and L.R.O. Storey.
J. geophys. Res., Vol. 63, No. 4. 671-82 (Dec., 1958).

A contribution to the ring-current theory of geomagnetic storms. It is concerned with estimating the delay that may elapse, due to the shielding effect of the conducting medium in the outer ionosphere, between the formation of the ring current and the occurrence of the resulting geomagnetic storm at the earth's surface. A previous estimate had placed this delay time as high as several months. However, it is shown that if proper account is taken of the fluidity of the medium and of the presence of the main geomagnetic field, the anticipated delay becomes so small that it no longer provides a basis for an objection to the ring-current hypothesis.

550.385

4121. INADEQUACY OF RING-CURRENT THEORY FOR THE MAIN PHASE OF A GEOMAGNETIC STORM. E.N.Parker.
J. geophys. Res., Vol. 63, No. 4, 683-9 (Dec., 1958).

It is demonstrated that there is apparently not enough dissipation to allow significant diffusion, during a magnetic storm, of the magnetic fields in the vicinity of the earth. It is then demonstrated that a ring-current field can only increase the horizontal component of the geomagnetic field, and so cannot account for the main phase of a geomagnetic storm. Thus, other storm mechanisms must be sought.

550.385

4122. STATEMENT OF DIFFERENCES REGARDING THE RING-CURRENT EFFECT. C.O.Hines and E.N.Parker.
J. geophys. Res., Vol. 63, No. 4, 691-2 (Dec., 1958).

550.385

4123. STUDIES ON GEOMAGNETIC STORM IN RELATION TO GEOMAGNETIC PULSATION. Y.Kato and T.Watanabe.
J. geophys. Res., Vol. 63, No. 4, 741-56 (Dec., 1958).

The sudden commencement storm should be described as the compression of the outer-atmospheric matter due to the corpuscular stream. The main phase field is pictured as the hydromagnetic rotation of the outer atmosphere. The structure of the solar corpuscular stream responsible for the 27-day recurring magnetic disturbance can be modelled well by Pecker–Roberts' "cone of avoidance" structure, which is favoured by both magnetic and cosmic-ray phenomena. The sporadically occurring geomagnetic storm (the S type) corresponds to the corpuscular stream with the shock front formed in the interplanetary matter. The determining of the storm-time variation of the activity of the geomagnetic pulsation (pc type) assists in conjecturing the structure of the corpuscular stream.

551.46.018.3

4124. THEORY OF THE ELECTROMAGNETIC METHOD OF MEASURING OCEAN CURRENTS. L.Cagniard.
Ann. Geophys., Vol. 13, No. 2, 155-7 (1957). In French.

A brief account of a method which is in practical use. The sea water is regarded as a conducting medium moving, with vector velocity varying with depth, in the earth's magnetic field. By solving the electromagnetic equations, the vector electric field is calculated as a function of depth. Conversely, by measuring the electric field at various depths, the velocity distribution of the water may be calculated. P.M.Davidson

ATMOSPHERE . IONOSPHERE

551.508.2 : 535.23.08

CONVECTION-FREE INSTRUMENT FOR MEASURING INFRARED RADIATION IN THE ATMOSPHERE. See Abstr. 3242

551.508.99 : 535.322.4

4125. A NEW TYPE REFRACTIVE INDEX VARIOMETER. K.Hirao and K.Akita.
J. Radio Res. Lab. (Tokyo), Vol. 4, 423-37 (Oct., 1957).

Atmospheric refractive index variation in the frequency range of radio waves can be expressed as the linear combination of both dry- and wet-bulb temperature variations. A new type refractive index variometer based on this principle has been designed and constructed. In the present paper, this variometer is described in detail. Some observational data are shown with radiometeorological considerations.

551.510.3

4126. SUMMER-DAY AURORAL-ZONE ATMOSPHERIC-STRUCTURE MEASUREMENTS FROM 100 TO 210 KILOMETERS. R.Horowitz and H.E.LaGow.
J. geophys. Res., Vol. 63, No. 4, 757-73 (Dec., 1958).

The density and pressure of the atmosphere from 100 to 210 km above Fort Churchill, Manitoba, Canada, were determined from a rocket flight on 29 July 1957, at 4.00 p.m., C.S.T. Two magnetic cold-cathode ionization gauges were used to measure pressure and pressure changes on the side of the rolling rocket. Excellent agreement was obtained (a) between both gauges throughout flight, and (b) between ascent and descent measurements. Measured pressures in the region from 100 to 120 km were corrected for a residual gas pressure of approximately 2×10^{-5} mm Hg. An ambient pressure of 10^{-4} mm Hg was obtained at 107 km. The derived pressure of 4×10^{-6} mm Hg at 210 km is an order of magnitude greater than the corresponding 1951 values measured at the White Sands Proving Ground, New Mexico. Densities were measured from 125 to 210 km. The density value of 6×10^{-7} gm/m^3 at 210 km is five times greater than the 1951 measurement, while at 140 km the difference is a factor of two. Scale heights (RT/Mg) were derived from the measured pressure and density data v. altitude, using the hydrostatic equation. The scale-height value obtained at 210 km was 95 km and the scale-height gradient from 190 to 210 km was 0.1 km/km.

551.510.3 : 525.3

SCALE HEIGHT OF THE UPPER ATMOSPHERE. See Abstr. 3075

551.510.3 : 525.3

DIURNAL VARIATIONS IN HIGH-ALTITUDE AIR DENSITY. EARTH SATELLITE OBSERVATIONS. See Abstr. 3076

551.510.53 : 523.152

THE INTERPLANETARY MEDIUM AND THE UPPER ATMOSPHERE. See Abstr. 3039

551.510.535

4127. ROCKET MEASUREMENTS OF ELECTRON CONCENTRATION IN THE IONOSPHERE USING A V.H.F. DISPERSION INTERFEROMETER. K.I.Gringauz.
Dokl. Akad. Nauk SSSR, Vol. 120, No. 6, 1234-7 (1958). In Russian.

The concentration was obtained by measuring phase differences between signals from a rocket fired at a small angle to the vertical. The signals were emitted by two radio transmitters mounted on the rocket (48 Mc/s and 144 Mc/s). The maximum height reached was 473 km. S.Chomet

551.510.535

4128. IONOSPHERIC DISTURBANCES AT LOW LATITUDES. A.P.Mitra.
J. sci. industr. Res., Vol. 17A, No. 12(Suppl.), 37-40 (Dec., 1958).

Data from a number of Indian ionospheric stations have been used to study the anomalous changes in f_o F2 during magnetic disturbances at low latitudes. Some evidence is produced which indicates that the storm current flow in the E region at these latitudes is in an opposite direction to that at Washington (38°N). H.J.A.Chivers

551.510.535 : 523.164 : 621.396.822

4129. STUDIES OF COSMIC RADIO NOISE ON 25 Mc/s AT AHMEDABAD. R.V.Bhonsle and K.R.Ramanathan.
J. sci. industr. Res., Vol. 17A, No. 12, 40-5 (Dec., 1958).

The aerial used for these studies was a broadside collinear array of 16 $\lambda/2$ dipoles spread in the E–W direction and backed by a parallel-wire reflector at a distance of 0.2λ, the principal lobe being directed towards the zenith. All the records of cosmic noise obtained in the period March, 1957, to February, 1958, were utilized to develop a curve for the cosmic noise power (on 25 Mc/s) outside the atmosphere against sidereal time. Comparison of the record obtained on any particular day with this standard curve enabled the attenuation produced by the ionosphere to be calculated. The method adopted for separating the attenuations due to the D and F regions, which are mainly responsible for the attenuation, was that used by Mitra and Shain. The diurnal and seasonal variations of the attenuation in these regions are discussed in some detail. The results for the F2 layer show that the absorption has a curvilinear relation with the value of f_0F2, and that for high values of f_0F2 it may exceed the absorption of the D layer. In general, for any particular value of f_0F2, the night-time F2 attenuation during all seasons was > the day-time attenuation. The large differences between night and day F2 attenuation values observed in the early part of the night will be discussed in a later paper. A.Wilkinson

551.510.535 : 523.53 : 621.396.8

4130. METEORS AND E_s IONIZATION. K.M.Kotadia.
J. sci. industr. Res., Vol. 17A, No. 12, 46-9 (Dec., 1958).

Records obtained at Ahmedabad and at Yamagawa of the occurrence of sporadic E ionization are shown graphically in relation to Jodrell Bank data on the hourly rates of meteors during various day-time and night-time meteor showers. The graphs give definite evidence of the positive influence of meteors on E_s ionization in low latitudes of the northern hemisphere. The ionization is produced at heights in the range 95-105 km and is usually at a lower level than the base of the normal E layer. The seasonal variation of the occurrence of E_s layers at Ahmedabad has been found to agree well with that of meteors. The smaller day-time showers had a more pronounced effect on E_s ionization than the larger night-time showers. The fact that the times of peak meteor activity at Jodrell Bank and of peak E_s ionization at Ahmedabad are nearly the same indicates that the meteors in a shower are widely spread over the earth. A.Wilkinson

551.510.535 : 621.396.812.3

4131. RATES OF FADING OF REFLECTED PULSES OF VERTICALLY INCIDENT ELECTROMAGNETIC WAVES AT AHMEDABAD ON 2.6 AND 4.0 Mc/s. R.Sethuraman.
J. sci. industr. Res., Vol. 17A, No. 12, 50-3 (Dec., 1958).

The results of a study of the variations of the fading periods of the reflected signals during the period Oct., 1956 to March, 1958, are summarized. Rapid fading, with periods < 5 sec, occurs mostly during the night hours. No clear seasonal effects are evident. The fading periods show some dependence on magnetic activity, low values of C_p being generally associated with more rapid fading. The night-time F2 layer is found to be sensitive to changes of magnetic activity; the day-time E layer does not show any marked effect. The fading periods of night-time F2 reflections have a marked correlation with the amount of spread F present in the p'f records, large amounts of spread being associated with quicker fading. No relation was found between fading period and the speed of ionospheric drift or the height of reflection. A.Wilkinson

551.510.535 : 621.396.8

4132. A NEW CONTINUOUS WAVE RADIO METHOD FOR THE STUDY OF IONOSPHERIC DRIFTS.
B.Ramachandra Rao and D.Satyanarayana Murty.
J. sci. industr. Res., Vol. 17A, No. 12, 63-7 (Dec., 1958).

A report of further measurements of ionospheric drifts by the method previously described [see Abstr. 1026B/1957; Nature (London), Vol. 177, 1222-3, June 30 (1956)], which utilizes 3 vertical aerials located at the corners of a right-angled triangular plot whose N–S and E–W legs are 64 and 60 m respectively. The results obtained for the E and F2 regions are tabulated. Comparison of the results with those obtained with the standard spaced-receivers pulse method shows that the authors' method gives reliable and consistent results. It has the advantage that, by proper choice of operating frequency, drifts at different points of the ionosphere can be determined by means of observations at a single receiving centre. A.Wilkinson

551.510.535

4133. ELECTRON DENSITY PROFILES IN THE IONOSPHERE DURING THE I.G.Y. R.L.Smith-Rose
J. geophys. Res., Vol. 63, No. 3, 570-2 (Sept., 1958).

Electronic computers now make it feasible to extract from normal ionograms, systematic data on the variations of electron density with height. This work is now in progress on records collected during the I.G.Y. H.J.A.Chivers

551.510.535

4134. CONCERNING BOOKER'S THEORY OF METEORIC REFLECTIONS. L.A.Manning and V.R.Eshleman.
J. geophys. Res., Vol. 63, No. 4, 737-9 (Dec., 1958).

The existence of small-scale ionospheric turbulence as assumed by Booker (Abstr. 5539/1958) conflicts with many of the known facts concerning meteoric echoes. The reasons for this conflict are given in some detail.

551.510.535

4135. POLAR Es. R.Penndorf and S.C.Coroniti.
J. geophys. Res., Vol. 63, No. 4, 789-802 (Dec., 1958).

Three distinct types of polar Es exist: Thule, Auroral Belt, and Mixed type. The Thule type, which is restricted to the area close to the geomagnetic pole (north of 73° geomagnetic latitude), shows a summer maximum occurring around geomagnetic noon. It follows Universal time. The Auroral Belt type occurs along the

Auroral Belt and appears only at night. It follows local time. No appreciable change with season or sunspot activity is found. The mixed type is found along the demarcation line of these two types, for example, at Baker Lake; that is, during some months the Thule type prevails, whereas in other months the Auroral Belt type prevails. Another mixed type occurs at the southern limits of the Auroral Belt type, around 60° geomagnetic latitude. The geographic extent of each type is shown on a polar map. The strong correlation of Es and magnetic activity point to a direct or indirect influence of corpuscular radiation on the occurrence of Es in the polar region.

551.510.535

4136. STUDY OF THE E-LAYER WINDS WITH CONTINUOUS-WAVE RADIO SIGNALS. R.N.Singh and A.Prakash.

J. sci. Res. Banaras Hindu Univ., Vol. 8, No. 1, 117-26 (Dec., 1957).

Analysis of fading records of oblique-incidence c.w. transmissions from broadcasting stations received simultaneously at three spaced sites has given an average E-layer drift velocity of 20 m/sec in a direction 20°-45° south of east. The experimental arrangements and the methods of analysis of the records are described. G.M.Brown

551.510.535

4137. PREVAILING WIND IN THE IONOSPHERE AND GEOMAGNETIC S_q VARIATIONS. S.Kato.

J. Geomagn. Geoelect., Vol. 9, No. 4, 215-17 (1957).

551.510.535

4138. HORIZONTAL DRIFT MEASUREMENTS IN THE IONOSPHERE NEAR THE EQUATOR.

N.J.Skinner, J.Hope and R.W.Wright.

Nature (London), Vol. 182, 1363-5 (Nov. 15, 1958).

Measurements of the east—west drift components in the E and F layers at Ibadan by the spaced-receiver method show that these are towards the west during daytime, and towards the east at night, and in opposite phase to those found in temperate latitudes. These results are in agreement with Martyn's theory, although the magnitude of the westward drift in the F-layer (105 m/sec. at magnetic latitude $2\frac{1}{2}^\circ$S) is smaller than that predicted for a station situated directly under the equatorial electrojet. The amplitude pattern observed on the ground for both layers is found to be elongated in the direction of the magnetic meridian. G.M.Brown

551.510.535 : 621.396.821

4139. A THEORETICAL INVESTIGATION ON THE PROPAGATION PATH OF THE WHISTLING ATMOSPHERICS.

K.Maeda and I.Kimura.

Rep. Ionosphere Res. Japan, Vol. 10, No. 3, 105-23 (Sept., 1956).

By the ray-theoretical treatment based on Fermat's principle, formulae necessary for the exact calculation of the ray path of a whistler have been deduced, and ray paths starting from various geomagnetic latitudes have been calculated, under the appropriate assumption of distribution of electron density in the outer ionosphere. It is shown that the ray path does not in general follow the line of magnetic force and especially in lower latitudes the path is not symmetric with respect to the magnetic equator. It is also shown that many of the facts so far observed at various latitudes can be explained by the results of this theoretical study. Some remarks are added on future experiments with a view to exploring the electrical and magnetic properties of the outer ionosphere.

551.510.535 : 621.396.8

4140. THE CHARACTERISTICS OF THE F2 REGIONS AS DEDUCED FROM THE DAILY VARIATIONS IN THE IONOSPHERIC LAYER. T.Shimazaki.

Rep. Ionosphere Res. Japan, Vol. 10, No. 3, 124-42 (Sept., 1956).

The differential equations of motion and of continuity of ionospheric F2 regions are solved numerically on some probable assumptions of the upper atmosphere. A general method of analysis is developed, in which every part of the ionosphere does not always return to the same level after 24 hr, but the profile of electron density v. height remains constant. The results obtained from comparison of calculated daily variations for different models of the F2 regions with observed variations are as follows: (1) the F2 layer is produced at a level much higher than that of maximum electron production as a result of height-dependent decay coefficient: (2) a positive temperature (or scale height) gradient is a very important existence in the F2 regions and thermal expansion during the daytime is larger in sunspot maximum years than in minimum and in summer and/or lower latitudes than in winter and/or higher latitudes: (3) the vertical tidal drift velocity has a non-uniform character and the amplitude increases and decreases with height in the ionospheric F2 regions developed at comparatively higher and lower levels, respectively. The phase of drift velocity advances or lags upwards as the amplitude increases or decreases with height. Calculated daily variations in the F2 layer then have a strong resemblance to observed variations in all seasons and latitudes except near the equator. Observed daily variations in various latitudes ma well be explained by gradual shifting, as a whole, of the phase of the semi-diurnal vertical drift velocity, whose amplitude increases and whose phase advances with height, in all seasons except daytime in winter. On the contrary, during daytime in winter, when the ionospheric layer is formed at a much lower level, they may well be explained by gradual shifting, as a whole, of the phase of the semi-diurnal vertical drift velocity, whose amplitude decreases and whose phase lags with height.

551.510.535 : 621.396.8

4141. ON RADIO PROPAGATION DISTURBANCES. K.Sinno.

Rep. Ionosphere Res. Japan, Vol. 10, No. 3, 143-7 (Sept., 1956).

Geomagnetic storms are divided into two groups, the first group having a 27-day recurrence period and the second group having no recurrence because of solar self-rotation. It is concluded that propagation disturbances which are caused by the first group are more severe than those caused by the second group. The 27-day recurrent type of magnetic storm has a tendency to occur often at the time when the calm region on the solar surface passes the central meridian of the sun, and the non-recurrent type of the storm corresponds to the solar active region. It is concluded that magnetic storms which are related to what is called the "M-region" have a greater effect on radio propagation disturbances.

551.510.535

4142. ON THE POSSIBILITY OF ESTIMATING THE UPPER SEMI-THICKNESS OF THE F_2 REGION OF THE IONOSPHERE FROM RECEPTION OF RADIO WAVES TRANSMITTED BY AN I.G.Y. SATELLITE. K.K.Majumdar.

Sci. and Culture, Vol. 24, No. 5, 236-8 (Nov., 1958).

It is shown that the time interval over which radio signals should be received at the earth during the transit of a transmitting artificial earth satellite, depends on various parameters including the semi-thickness of the F2 region above the level of maximum ionization density. All the parameters involved except the latter, can be measured by normal techniques. It is suggested that by timing the duration of signal reception at various points on the earth, it is possible to investigate the world-wide distribution of the upper semi-thickness of the F2 region. H.J.A.Chivers

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also the Section entitled "ELECTROMAGNETIC WAVES AND OSCILLATIONS".

551.510.536

4143. THE DENSITY OF THE OUTERMOST EARTH'S ATMOSPHERE FROM SATELLITE OBSERVATIONS.

H.K.Paetzold and H.Zschörner.

Naturwissenschaften, Vol. 45, No. 20, 485-6 (1958). In German.

Values are calculated from the changing period of the satellite for Sputnik I and III and Explorer I and Vanguard. It is suggested that variations in the density at these altitudes are common on the basis of the variations in the period of the satellites. J.M.Hough

551.521.11

4144. COMPLETE TABLES FOR THE DETERMINATION OF THE EXTERNAL SUNLIGHT EXPOSURE TOGETHER WITH ORIENTATION DIAGRAMS. M.Nicoli.

R.C. Ist. Super. Sanita, Vol. 21, Pt 6, 604-9 (1958). In Italian.

Gives detailed tables appropriate to Italy based on the theory of Tizzano (Ingegnere, No. 5-6, 1949). The same data is also presented in diagram form. J.M.Hough

551.521.326

4145. ANNUAL VARIATION OF THE BLUE LIGHT IN THE NIGHT SKY BY PHOTOGRAPHIC SPECTROPHOTOMETRY.

R.Robley.

Ann. Geophys., Vol. 13, No. 3, 222-30 (1957). In French.

Observations of intensities between 4000 A and 4500 A show that the strong bands at 4420, 4170 and 4070 have maxima in May and October, while the adjacent background has a strong maximum in January and is uncorrelated with the bands except over short periods. This supports the conclusion that there is a real continuum in the airglow, and appears to exclude the possibility of an extra-terrestrial origin for the variable part of the background radiation. J.Hawgood

551.521.6 : 550.385

4146. SOFT RADIATION EVENTS AT HIGH ALTITUDE DURING THE MAGNETIC STORM OF AUGUST 29-30, 1957. K.A.Anderson.
Phys. Rev., Vol. 111, No. 5, 1397-405 (Sept. 1, 1958).

During a balloon flight made from Fort Churchill on August 29, 1957, showers of X-rays were encountered at an atmospheric depth of about 11 g cm^{-2}. At times their flux was as high as 20 photons cm^{-2} sec^{-1} sterad^{-1}. The close connection between the appearance of these X-rays in the 100 keV energy region and storm-type decreases in the local geomagnetic field is shown. The one observation that bears on the point is consistent with these X-rays being produced by electron bremsstrahlung in the terrestrial atmosphere. There are features of the X-ray behaviour which show that the primary electrons must be local in character quite apart from geomagnetic cutoff considerations. By "local" is meant that the electrons either acquire the main part of their kinetic energy in the neighbourhood of the earth or that they are accelerated at the sun, are trapped in magnetic clouds and drift to the earth where they are released. It is suggested that acceleration of electrons is a rather general characteristic of the region surrounding the earth and that their association with aurorae and geomagnetic storms may be special features.

551.521.63 : 535.247.4

AN AUTOMATIC INSTRUMENT RECORDING DAYTIME ULTRA-VIOLET. See Abstr. 3251

551.574.1

4147. FREEZING NUCLEI OF THE ATMOSPHERE. G.Soulage.
Ann. Geophys., Vol. 13, No. 2, 103-34; No. 3, 167-85 (1957).
In French.

A detailed experimental and theoretical study of the atmospheric particles which can act as nuclei for ice crystals in supercooled clouds at temperatures above -20°C. The particles are of two types. Type I, with reproducible activity and of average diameter 10 μ, represents at the summit of Mt. Puy de Dôme where most of the experiments were performed, about 10% of the crystal residues in the air. They are classified into three groups according to their shape and size. The highest action threshold observed was -6°C. The mode of action and the origin of the particles are discussed. Type II, though some are similar in their properties to Type I, have been rendered inactive in consequence of having acted once as ice forming nuclei. The average value of the ice-forming power of the air was found to be 20 crystals per litre of air on Mt. Puy de Dôme. S.Weintroub

551.593.55

4148. PRESENCE OF 6707 A RADIATION IN THE TWILIGHT SKY. M.Gadsden and K.Salmon.
Nature (London), Vol. 182, 1598-9 (Dec. 6, 1958).

The discovery by Delannoy and Weill (Abstr. 1959/1959) of a new twilight emission at 6708 A, attributed to resonance radiation from the neutral Li atom, has been confirmed by the presence of the same line on twilight-sky spectrograms obtained with an I.G.Y. patrol spectrograph at Hallett Station, Antarctica during August 1958, and in New Zealand on September 5. The Hallett observations indicate that the height of the Li emission (rel. to that of Na) decreased during the period of the observations by ~ 0.4 km/day.
D.R.Barber

551.594.12 : 537.221

4149. ELECTRICALLY CHARGED DROPS FROM BUBBLES IN SEA WATER AND THEIR METEOROLOGICAL SIGNIFICANCE.
D.C.Blanchard.
J. Meteorol., Vol. 15, No. 4, 383-96 (Aug., 1958).

A modification of Millikan's oil-drop experiment was used to determine the electric charge and radius of drops that were ejected from a bursting bubble at an air-sea water interface. Charge measurements were made of both the natural and the induced charge. Drops of 2 to 20 μ in radius carry natural charges of at least 2×10^2 to 5×10^3 e.s.u., respectively. The induced charges are considerably higher, reaching 10^6 elementary units on drops of 50 μ radius. The sign of the natural charge is positive on drops $\sim< 4\ \mu$. For larger drops both the sign and magnitude of the charge appear to be a function of the depth of water through which the bubble rises. The meteorological significance stems from the fact that rain and snow, as well as whitecaps, can produce great numbers of small bubbles in the surface waters of the oceans. Both laboratory and field work suggest that the majority of these bubbles produce positively charged drops that contribute to the atmospheric space-charge. Of special significance is the fact that, for positive induction fields less than about 25 V/cm, a positive charge is found on the small drops. For fields greater than 25 V/cm the induced negative-charge exceeds the natural positive-charge and so the drops carry a net negative-charge. Consequently, small bubbles breaking at the surface of the sea in the presence of the earth's fair-weather positive field of about 1 V/cm will produce drops that carry a positive charge. Calculations based on measurements of the bubble spectrum produced by whitecaps indicate that the charge on the drops may, under some conditions, provide a counter-current of the same order of magnitude as the fair-weather conduction current. Thus the sea may be a source as well as a sink for the charge that maintains the earth's positive electric-field.

551.594.14

4150. ION-EXCHANGE PROCESS FOR THE MEASUREMENT OF SMALL β-RAY ACTIVITIES IN RAIN. A.Hinzpeter.
Naturwissenschaften, Vol. 44, No. 23, 611-12 (1957). In German.

An ion-exchange process is described for the extraction of β-ray active material from rain water in which the activity is usually of the order of 10^{-7} μc/ml. The β-ray activity of the extracted material is measured in one of four ways: (1) after removal of the resin layer from the filter paper, (2) after mixing of the resin charge in a mortar, (3) after ashing of the resin, (4) after elution of the active material with acid. R.Schnurmann

551.594.14 : 539.17

4151. RADIO-ACTIVE CARBON, PRODUCED BY ATOMIC EXPLOSIONS, IN THE ATMOSPHERE.
K.O.Münnich and J.C.Vogel.
Naturwissenschaften, Vol. 45, No. 14, 327-9 (1958). In German.

The increment of the C^{14} content of the atmosphere was measured in Central Europe and South Africa by examining the C^{14} content of plant tissues whose histories were accurately known. A marked increase during the last few years was observed; it was more pronounced in the northern hemisphere. By comparing this increment in either hemisphere, some indication of the mixing of the atmosphere was obtained. D.H.Lord

551.594.14

4152. THE ATOM BOMB EFFECT. RECENT INCREASE IN THE ^{14}C CONTENT OF THE ATMOSPHERE, BIOSPHERE, AND SURFACE WATERS OF THE OCEANS. T.A.Rafter and G.J.Fergusson.
New Zealand J. Sci. Technol. B, Vol. 38, No. 8, 871-83 (Sept., 1957).

Recent measurements of the C^{14} specific activity of the atmosphere of the southern hemisphere show that the C^{14} specific activity has been increasing at an approximately exponential rate since late 1954. The total increase by May, 1957, was $6.70 \pm 0.30\%$. The C^{14} specific activity of the contemporary portion of the biosphere has been shown to be increasing at the same rate. The only feasible explanation for this increase in C^{14} specific activity is the production of C^{14} from the testing of atomic weapons. An increase of $2.0 \pm 0.5\%$ in the C^{14} specific activity of the surface water of the ocean was observed by May, 1957. An exchange time of 20 months for transfer of carbon dioxide from the atmosphere to the surface water of the ocean has been deduced from the above measurements.

551.594.14

4153. RADIOACTIVE FALLOUT. W.F.Libby.
Proc. Nat. Acad. Sci. U.S.A., Vol. 44, No. 8, 800-20 (Aug., 1958).

This is a general survey of the mechanism of radioactive fallout containing several tables of Sr^{90} data and including some information on C^{14} and H^{3} distribution. M.A.Grace

551.594.14

4154. AN OBSERVATION ON THE RADIOACTIVITY OF THE AIR RESULTING FROM NUCLEAR BOMB EXPERIMENTS.
A.Aron and B.Gross.
Z. Naturforsch., Vol. 12a, No. 11, 944-5 (1957). In German.

Since the middle of 1956, daily measurements have been made of the activity in the air. Air was drawn through filters for 12 hours and their β-activity measured 4 to 6 days later. A single filter with extremely high activity was found. By measuring the decay of its activity, a fairly accurate estimate was made of the date of the explosion causing this activity. The high activity was shown to be due to a single particle. D.H.Lord

551.594.14

4155. MEASUREMENT OF THE RADIOACTIVITY OF THE AIR IN THE ANTARCTIC. E.Picciotto.
Nuovo Cimento, Vol. 10, No. 1, 190-1 (Oct. 1, 1958). In French.

The concentration of radioactivity at $70^{\circ}26'$S, $24^{\circ}19'$E was measured during Feb., 1958. Particles larger than 0.5 μm were filtered out of the air; α- and β-activity in the filter were measured.

Activity due to fission products varied between (1-4) × 10^{-14} c/m^3. ThB and RaB were measured directly. An α-activity is attributed provisionally to Po. Results are: RaB < 10^{-12} c/m^3, ThB < 5 × 10^{-14} c/m^3, Po 10^{-16} c/m^3. No trace of long-period elements was detected. The concentration of fission products was of the order of 1% of that in the northern hemisphere during the same period. From the intensity of natural radioelements it is inferred that the diffusion time of Rn is much greater than 3.8 days. P.G.Murphy

551.594.51

4156. ELECTRIC FIELD THEORY OF AURORAE. G.C.Reid.
Nature (London), Vol. 182, 1791-2 (Dec. 27, 1958).

An attempt is made to obtain a qualitative picture of the development of an auroral display on the tacit assumption that it is caused by the growth of an electrical field in the ionosphere, as the result of a potential difference across the lines of geomagnetic flux within the auroral zones. The main conclusions appear to fit the observational data satisfactorily, in particular the emission of X-radiation associated with the break-up of quiescent arcs into active rayed structures. The theory may also account for the detailed forms of local aurorae in terms of the localized distribution of electron density in the ionosphere at the time of the display. As yet no direct evidence is available to check this. D.R.Barber

551.596.1

4157. PATH OF SOUND TRAJECTORIES IN THE UPPER ATMOSPHERE. Y.Rocard.
C.R. Acad. Sci. (Paris), Vol. 247, No. 22, 1973-5 (Dec. 2, 1958).
In French.

Mathematical note suggesting that shock wave propagation may be a contributory factor in the anomalous distribution of sound from explosions. H.D.Parbrook

BIOPHYSICS
PHYSIOLOGICAL PHYSICS

578.087.77 : 532.570.8

REGISTRATION OF PHASIC CHANGES OF BLOOD FLOW BY MEANS OF A CATHETER-TYPE FLOWMETER. See Abstr. 3195

578.088.5

4158. CAN THE UNIT "RÖNTGEN" BE ESTABLISHED IN THE INTERVAL OF ENERGY (0.1 TO 100) MeV ? F.Demichelis.
R.C. Accad. Naz. Lincei, Vol. 22, No. 5, 610-13 (May, 1957).
In Italian.

It is suggested that the total attenuation of gamma-rays in polystyrene and in the human body have an approximately constant ratio in this interval and that this gives a means of defining the röntgen for such high-energy rays. J.M.Hough

578.088.5 : 539.1.07

POLYMER DEGRADATION — WIDE-RANGE DOSIMETER. See Abstr. 3697

578.088.5 : 539.1.07

PHOTOVOLTAIC GAMMA-RAY DOSIMETER. See Abstr. 3698

591.185.5

4159. AUDITORY PERCEPTION OF SUBMERGED OBJECTS BY PORPOISES. W.N.Kellogg.
J. Acoust. Soc. Amer., Vol. 31, No. 1, 1-6 (Jan., 1959).

612.014.481

4160. BETA AND GAMMA DOSE RATES FROM TERRESTRIALLY DISTRIBUTED SOURCES. K.O'Brien, W.M.Lowder and L.R.Solon.
Radiation Research, Vol. 9, No. 2, 216-21 (Aug., 1958).

Calculations are made of the dosage rates from U, Th, and K sources in equilibrium with their decay products, assumed distributed uniformly through the ground, at various heights in air and at various depths in tissue. The calculations permit an estimate of γ-ray dose to the gonads to be made. Ratios of surface to gonad doses agree within 4% with values set out in the M.R.C. report on "The Hazards to Man of Nuclear and Allied Radiations" (1956). C.B.Allsopp

612.843.31

4161. ON THE ALTERNATING CURRENT WAVEFORMS IN THE EYE DERIVED FROM PHYSIOLOGICAL OPTICS. E.Gehrcke.
Optik, Vol. 15, No. 2-3, 94-7 (Feb.-March, 1958). In German.

The waveforms deduced from the colour sensations caused by light-dark stimuli explain the scale-of-greys and colour mixing effects. E.A.Mussett

612.843.31 : 535.653

4162. N.P.L. COLOUR-MATCHING INVESTIGATION: FINAL REPORT (1958). W.S.Stiles and J.M.Burch.
Optica Acta, Vol. 6, No. 1, 1-26 (Jan., 1959).

The second part of the N.P.L.'s colour-matching investigation was devoted to determining average colour-matching properties in a large (10^0 diameter) bipartite matching field, and the final corrected results are here presented in tabular form, together with a specification of the conditions of measurement, and ancillary data on repeatability. The tabulated results comprise (a) mean colour-matching functions, referred to reference primaries at wave-numbers 15 500, 19 000 and 22 500 cm^{-1}, for spectral stimuli in the range 12 000 to 25 500 cm^{-1}, given at intervals of 250 cm^{-1} between 16 000 and 22 000 cm^{-1} and at intervals of 500 cm^{-1} outside these limits, (b) the standard deviations and correlation coefficients of the colour-matching functions at wave-numbers between 14 000 and 25 500 cm^{-1}, (c) mean colour-matching functions corrected for rod intrusion in the range 12 000 to 17 000 cm^{-1}, (d) the corresponding mean unit coordinates in a W.D.W. system, and their standard deviations, (e) the mean relative luminosity factors of the reference primaries and their standard deviations determined by both direct-comparison and flicker heterochromatic matching, (f) the mean relative luminosity function V_λ in the range 12 000 to 15 000 cm^{-1} determined by direct comparison with 14 250 cm^{-1}. The main colour-matching results are based on 49 subjects, but the results for spectral stimuli of wave-number less than 14 000 cm^{-1} rest on fewer subjects. The extent to which the results show an increase with age in the yellow pigmentation of the eye is discussed.

612.843.45

4163. SIMULTANEOUS BRIGHTNESS CONTRAST AND THE PULFRICH PHENOMENON. A.L.Diamond.
J. Opt. Soc. Amer., Vol. 48, No. 12, 887-90 (Dec., 1958).

If an object, moving from left to right, is viewed binocularly by an observer, and if a brightness reducing filter is placed in front of the observer's left eye, the moving object will appear to be further away than it actually is. This demonstrates the Pulfrich phenomenon. The brightness of an object can be reduced in another way, through an intense inducing field, or glare source, placed nearby the object. This illustrates simultaneous brightness contrast. The present investigation concerns whether the Pulfrich phenomenon would occur if the brightness of the moving object were reduced (in one eye) not by a filter, but by an inducing field. Eight observers were used. When a filter was placed in front of the observer's left eye, this produced a displacement of the moving object away from the observer. This was the Pulfrich effect. When an inducing field was presented slightly peripherally to the observer's left eye, this produced a displacement of the moving object toward the observer, or in the opposite direction of the Pulfrich phenomenon. Displacement was directly proportional to inducing luminance. A "reverse" Pulfrich phenomenon occurred, therefore, when the brightness (to one eye) of a moving object was reduced by an inducing field rather than by a filter. From these results we can assume that the physiological mechanism for brightness reduction by an inducing field is different in whole or in part than that mechanism for brightness reduction by a filter.

612.843.613

4164. QUANTAL DETERMINATION AND STATISTICAL EVALUATION OF ABSOLUTE FOVEAL LUMINOSITY THRESHOLDS AND OF THRESHOLD VARIABILITY. D.J.Dillon and R.T.Zegers.
J. Opt. Soc. Amer., Vol. 48, No. 12, 877-83 (Dec., 1958).

Foveal luminosity thresholds to 31 stimulus wavelengths of light were obtained from five observers and expressed in radiometric units. The 31 wavelengths ranged from 400 to 700 mμ at intervals of 10 mμ. The flash duration and test patch size were 50 msec and one degree of arc. Each observer sat for ten experimental sessions. One complete luminosity curve based upon five determinaions at each stimulus wavelength was determined at each session. Variability values, in terms of coefficients of variation, were computed for each observer, session, and wavelength. The corneal hreshold value, at 550 mμ, averaged for all five observers, was approximately 14 600 quanta. The average retinal threshold value, .e., the corneal value corrected for absorption by ocular media, was approximately 8000 quanta. The latter figure yielded a cone hreshold of two quanta for three cones. An analysis of covariance of the standard deviations revealed that wavelength exerted a very significant effect ($P < 0.001$) on these SD's for three observers; a esser effect ($P < 0.02$) for one observer; and exerted no effect for he fifth observer. Pearson correlation coefficients, expressing this wavelength-variability relationship, were computed. The results paralleled exactly those of the covariance analysis: the same three observers exhibited a significant negative relationship ($P < 0.01$); the same individual yielded a barely negative relationship ($P < 0.10$); and the fifth displayed no correlation between wavelength and variability.

612.843.721

4165. EFFECT OF STEREOIMAGE DECENTRATION ON APPARENT SIZE. S.Renshaw.

J. Opt. Soc. Amer., Vol. 48, No. 11, 790-3 (Nov., 1958).

Decentration of stereoimages crossed makes a figure appear nearer and smaller; uncrossed makes it look larger and more remote. Quantification of these effects is presented with an orthogonal equation describing the interactions of distance from the observer, magnitudes of the decentrations crossed and uncrossed, and phenomenal judgment of apparent size. A 30 × 30 cm white square was photographed in orthostereo at distances of 3, 6, 12, 24, 48, and 96 m. Decentrations of 0 to 60 mm of the projected images in 10 mm steps were made and matched with an adjacent variable square. Some comment is made concerning the theoretical and practical bearings of the results.

612.843.721

4166. NOTE ON STEREOSCOPIC ACUITY AND OBSERVATION DISTANCE. K.N.Ogle.

J. Opt. Soc. Amer., Vol. 48, No. 11, 794-8 (Nov., 1958).

Stereoscopic thresholds were determined for viewing distances of 0.5 m and 10 m in an instrument which essentially eliminates empirical factors to visual depth discrimination. The results with three observers show that there is no change in stereoscopic acuity at these two distances. On the basis of this result, data from a particular experiment reported in the literature which seemed to show an increase in stereoscopic acuity with increase in viewing distance were examined. It is shown that the results obtained might be better explained entirely on the basis of an empirical factor that depends upon the least perceptible difference in the angular sizes of two test objects of equal size and form set at different distances.

612.843.721

4167. ANALYSIS OF EXPERIMENTS IN BINOCULAR SPACE PERCEPTION. A.A.Blank.

J. Opt. Soc. Amer., Vol. 48, No. 12, 911-25 (Dec., 1958).

Experiments connected with Luneberg theory as developed by the author (Abstr. 2717/1958) are analysed with the purpose of making explicit their underlying assumptions. In particular, the role of ad hoc assumptions is explored in detail and minimized wherever possible. It is shown that the special assumptions under which much of the experimental work was executed may be considerably broadened thereby indicating how the theory may be more directly founded upon experiment. The principal problem is the determination of the sensory visual transformation between the geometry of the binocular perception and that of the stimulus, and, in particular, the determination of the visual radial distance function. Three principal techniques, the double circumhoropters, the Blumenfeld alleys and the equipartitioned geodesics are discussed from this generalized point of view. The specific experimental material treated here consists of results obtained by Zajaczkowska, Shipley, and the Knapp Laboratory group at Columbia University. Some of these results appear for the first time. Theoretical material presented for the first time consists most notably of the analysis of the equipartitioned geodesics, the two-point experiments for the determination of Gaussian curvature, and the metatheoretical discussions of the several experiments.

612.844

4168. DEPTH OF FOCUS OF THE HUMAN EYE. K.N.Ogle and J.T.Schwartz.

J. Opt. Soc. Amer., Vol. 49, No. 3, 273-80 (March, 1959).

Depth of focus of the human eye is determined by the loss of resolving power (visual acuity) with increase in out-of-focus blurring of the retinal image. An instrument is described which permits accurate measurement of these phenomena, using psychophysical methods with the checkerboard visual-acuity test chart. All test conditions are held constant, binocular vision is maintained, and time of exposure of the test target is limited to 0.2 sec. Depth of focus was measured under the two following conditions: (1) increase in the angular size of the test target, and (2) increase and decrease of pupil size as effected by suitable drugs. With the angular size of the test target equivalent to 20/25 Snellen notation, for three subjects the mean total depth of focus was found to be 0.94 diopter at the 50% level of probable visual resolution of the target details and 0.63 diopter at the estimated 99% level. It was found that for each step of increase in target size (20/25 to 20/30, and so on) the total depth of focus increased by about 0.35 diopter. It was found also that over the range of pupil size from 2.5 to 8.0 mm the total depth of focus decreased about 0.12 diopter per millimeter of increase in the size of the pupil. These results were reviewed with respect to hyperfocal distance.

612.845.9

4169. HIGH-SPEED INFRARED OPTOMETER. F.W.Campbell and J.G.Robson.

J. Opt. Soc. Amer., Vol. 49, No. 3, 268-72 (March, 1959).

The various methods which have been used to detect changes in the refractive power of the eye due to accommodation are reviewed. An optometer of new design is described which uses infrared energy and therefore possesses the advantage of not acting as a glare source or as a stimulus to accommodation. The instrument has a noise equivalent to about 0.05 diopters when it is adjusted to detect fluctuations of accommodation from 0 to 5 c/s. Normal fixation movements of the eye do not interfere with the measurements of refractive power. The optometer as described has been constructed from standard optical components which make it suitable for use in research, but it might readily be modified to suit particular users.

612.846

4170. NEW TECHNIQUE FOR THE MEASUREMENT OF SMALL EYE MOVEMENTS. T.N.Cornsweet.

J. Opt. Soc. Amer., Vol. 48, No. 11, 808-11 (Nov., 1958).

A technique has been developed for recording eye movements as large as three or four degrees, with a precision of about ten seconds of arc. The technique is not subject to artifacts when the head moves, or if the eye should shift in its socket, and no attachment to the eye is required. A very small spot of light is focused on the subject's retina and is made to scan repeatedly across the optic disk. Light reflected back out of the eye is projected on to a photomultiplier tube which drives the vertical amplifier of a cathode-ray oscilloscope. The horizontal sweep of the oscilloscope is triggered in synchrony with the scanning spot. In the optic disk, the blood vessels absorb considerably more light than their whitish background. Therefore, each time the scanning spot passes over a blood vessel, a vertical deflection is registered on the oscilloscope. The distance between the beginning of the scan and this vertical deflection measured the optical position of the retina with respect to any stationary external stimulus. Changes in this distance represent movements of the eye.

612.846

4171. ANALYSIS OF EYE MOVEMENTS DURING FREE SEARCH. A.Ford, C.T.White and M.Lichtenstein.

J. Opt. Soc. Amer., Vol. 49, No. 3, 287-92 (March, 1959).

The positive polarity of the human cornea was used to produce signals from marginal electrodes around the eyes. The potentials were amplified with d.c. networks which produced amplitude-time oscillographic tracings of the horizontal and vertical components of eyeball movement, and also controlled the deflectors of a cathode-ray oscilloscope (c.r.o.) in such a way that the beam moved in the same way as the eyes. An automatic camera photographed the c.r.o. face to produce two-dimensional electro-oculographic (e.o.g.) plots of eyeball movement. Data thus obtained are used for an analysis of eye movements and fixations in a surveillance search task. The paper oscillographic tracings against time show (1) the number of fixations per unit of time, and (2) the duration of the fixations. The cathode-ray e.o.g. shows (1) the order of fixations in search procedure; (2) the lengths of various saccadic jumps, and (3) the areas of neglect and concentration for 5 sec search periods on a circular field subtending 30° of visual angle.

612.85 : 534.831

4172. MESSAGE REPETITION AND RECEIVER CONFIRMATION OF MESSAGES IN NOISE. E.C.Carterette.
J. Acoust. Soc. Amer., Vol. 30, No. 9, 846-55 (Sept., 1958).

A receiver may be required to decide whether the message he has recorded is or is not the message actually received. The degree of certainty needed for confirmation (the criterion) may be controlled by instructions. A sequence of decisions is generated by repeatedly sending each of a set of messages until the set is confirmed. A simple stochastic model assumes that the probability of confirmation, p_y, is constant over such a sequence. If N messages are sent, the expected number confirmed after the first n presentations is $E(n) = N[1-(1-p_y)^n]$. Two experimental tests were (1) of the constancy of p_y by noting whether the equation for E(n) holds, and (2) of the constancy of p_y's three component probabilities: the probabilities of correct reception, correct confirmation, and incorrect confirmation. Receivers listened under two noise conditions to sets of several hundred messages each. Each message was immediately repeated until confirmed. Estimates of p_y and of the component probabilities were made from proportions of correct and incorrect responses. The data show that the assumption of constant p_y yields a very accurate description of the process, and justify the more basic assumption that p_y's three components are constant over repeated trials. Further, the data are in excellent agreement with predictions from the theory of the total number of communication events required before the entire set of N messages is confirmed, and of the total numbers of correct and incorrect confirmations.

612.85

4173. DETECTION OF MULTIPLE COMPONENT SIGNALS IN NOISE. D.M.Green.
J. Acoust. Soc. Amer., Vol. 30, No. 10, 904-11 (Oct., 1958).

The detectability of a complex signal, one generated by adding two sinusoids, and partially masked by white noise, is determined. Several frequencies and three durations are used for the signal. The experimental determinations are compared with three mathematical models. These models are all interpretable as an extension of the critical band concept. The data are best explained by a model in which it is assumed that two or more critical bands may be linearly combined. This implies that the auditory mechanism may change the appropriate parameters of the analysis process in order to match the signal to be detected.

612.85

4174. MONAURAL TEMPORARY THRESHOLD SHIFT FOLLOWING MONAURAL AND BINAURAL EXPOSURES. I.J.Hirsh.
J. Acoust. Soc. Amer., Vol. 30, No. 10, 912-14 (Oct., 1958).

612.85

4175. DEPENDENCE OF TEMPORARY THRESHOLD SHIFT AT 4 kc ON INTENSITY AND TIME. W.D.Ward, A.Glorig and D.L.Sklar.
J. Acoust. Soc. Amer., Vol. 30, No. 10, 944-54 (Oct., 1958).

612.85

4176. RESIDUAL EFFECTS OF LOW NOISE LEVELS ON THE TEMPORARY THRESHOLD SHIFT. W.J.Trittipoe.
J. Acoust. Soc. Amer., Vol. 30, No. 11, 1017-19 (Nov., 1958).

612.85

4177. DIFFERENCE LIMEN FOR TONE DIMINUTION. R.E.Kirk.
J. Acoust. Soc. Amer., Vol. 30, No. 10, 915-18 (Oct., 1958).

The difference limen for tone diminution was investigated with diminution rate, fundamental frequency, and tonal complexity as parameters.

612.85

4178. WHAT IS MASKING? W.P.Tanner, Jr.
J. Acoust. Soc. Amer., Vol. 30, No. 10, 919-21 (Oct., 1958).

Three experiments are presented and analysed in terms of a conventional definition of masking and a masking index conforming to this definition. It is demonstrated that, even though all of these experiments yield data permitting calculation of the masking index, at least three distinct processes lead to these data: signal masking, distortion of the sound waveform, and listener distraction. Either masking theories should take these three processes into account, or masking should be re-defined.

612.85

4179. DEFINITIONS OF d' AND η AS PSYCHOPHYSICAL MEASURES. W.P.Tanner, Jr and T.G.Birdsall.
J. Acoust. Soc. Amer., Vol. 30, No. 10, 922-8 (Oct., 1958).

The efficiency, η, is defined as the ratio of the energy required by an ideal receiver to the energy required by a receiver under study when the performance of the two is the same. The measure d' is that value of $(2E/N_0)^{1/2}$ necessary for the ideal receiver to match the performance of the receiver under study, where E is the energy of the signal, and N_0 is the noise power per unit band-width. The measure is extended to include the recognizability of two signals. Every set of signals is described by a Euclidean space in which distances are the square roots of the energy of the difference signal, $(E_\Delta)^{1/2}$. The unit of measure is the square root of one-half of the noise power per unit band-width $(N_0/2)^{1/2}$.

612.85

4180. HARMONIC DISTORTION IN COCHLEAR MODELS. J.Tonndorf.
J. Acoust. Soc. Amer., Vol. 30, No. 10, 929-37 (Oct., 1958).

612.85 : 591.485

4181. LOCALIZATION OF AURAL HARMONICS ALONG THE BASILAR MEMBRANE OF GUINEA PIGS. J.Tonndorf.
J. Acoust. Soc. Amer., Vol. 30, No. 10, 938-43 (Oct., 1958).

612.85 : 534.79

4182. ADVANTAGES OF THE DISCRIMINABILITY CRITERION FOR A LOUDNESS SCALE. W.R.Garner.
J. Acoust. Soc. Amer., Vol. 30, No. 11, 1005-12 (Nov., 1958).

It is argued that a loudness scale based on the discriminability criterion would be better than one based on those methods which assume that direct numerical responses adequately reflect the nature of the loudness experience. The evidence and argument presented show: First, there is just as good a logical basis for accepting the discriminability criterion as for accepting the direct criterion. In both cases one has to assert a face validity which is arbitrary and may be incorrect. Second, the scales based on the discriminability criterion show less interobserver variability, are influenced less by specific experimental conditions, and are less affected by stimulus context than scales based on the fractionation procedure — the major direct response method used. Third, and most important, most of the direct response procedures themselves give results which agree with scales based on a discriminability criterion. It is, in fact, only the ratio scaling or fractionation procedures which give results at variance with all the rest.

612.85

4183. SIGNAL DETECTION AS A FUNCTION OF FREQUENCY ENSEMBLE. I. F.A.Veniar.
J. Acoust. Soc. Amer., Vol. 30, No. 11, 1020-4 (Nov., 1958).

This paper presents the results of an experimental investigation of the detection of a signal in noise as a function of signal ensemble size and ensemble frequency range. By signal ensemble size the author means the number of signals of different frequency that are equally likely to occur and which the observer must try to detect. By ensemble frequency range the author means the frequency separation between the lowest and the highest frequency signals included in that ensemble. Data are presented for the four observers who took part in the experiment. The results obtained are compared with predictions based upon three mathematical models. Using efficiency measures, the results obtained are also compared with performance expected of a mathematically optimum detector. Finally, the possibility is suggested that the models discussed are not necessarily mutually exclusive, but rather complementary in the over-all view of detection.

612.85

4184. SIGNAL DETECTION AS A FUNCTION OF FREQUENCY ENSEMBLE. II. F.A.Veniar.
J. Acoust. Soc. Amer., Vol. 30, No. 12, 1075-8 (Dec., 1958).

This paper presents the results of a second experimental investigation of the detection of a signal in noise as a function of signal ensemble size and ensemble frequency range. Data are presented for the three observers who took part in the experiment. The results obtained are compared with (1) predictions based upon three mathematical models, (2) performance expected of a mathematically optimum detector, and (3) results obtained in the first of these investigations.

612.85

4185. COMPARISON OF HEARING THRESHOLDS IN AIR AND IN WATER. W.N.Wainwright.
J. Acoust. Soc. Amer., Vol. 30, No. 11, 1025-9 (Nov., 1958).

Hearing thresholds were measured for two subjects over a frequency range of 250 c/s to 4000 c/s. These measurements were made both in air and in water. When threshold intensity levels are compared, it is shown that the greatest loss in hearing acuity in water occurred over the frequency range from 500 c/s to 2000 c/s and amounted to approximately 20 dB, while below 300 c/s the threshold intensity in water was lower than that in air. Measured intensity levels for an underwater swimmer speaking into a face mask are also presented.

612.85

4186. EFFECT OF AUDITORY CUE ON DISCRIMINATION OF AUDITORY STIMULI. F.A.Veniar.
J. Acoust. Soc. Amer., Vol. 30, No. 12, 1079-81 (Dec., 1958).

This report presents the results of an investigation dealing with (1) signal discrimination as a function of frequency range of the stimulus ensemble, and (2) the effect of auditory cue on discrimination of auditory stimuli as a function of frequency differences between cues and subsequent stimuli. Data are presented for three observers. The results obtained are compared with predictions based upon the null hypothesis and a narrow-band scanning model.

612.85

4187. INTELLIGIBILITY AT HIGH VOICE LEVELS AND THE USE OF A MEGAPHONE. J.M.Pickett and I.Pollack.
J. Acoust. Soc. Amer., Vol. 30, No. 12, 1100-4 (Dec., 1958).

A small megaphone was tested for use in direct voice communication at high levels of vocal output against backgrounds of noise. Intelligibility scores were determined for 12 talkers, speaking with and without the megaphone, over a range of field voice levels of 70 to 100 dB SPL (at 1 m). Nearly the entire over-all acoustical gain produced by the megaphone was realized in improved intelligibility above backgrounds of white noise and low-frequency noise. The acoustical gain of the megaphone permitted a lower voice level, and, hence, delayed the deterioration in intelligibility associated with distortions due to shouting. Frequency shifts in the voice spectrum were measured, with and without the megaphone, over a range of vocal efforts from conversational to maximum shout. Control tests demonstrated that the voice-frequency shifts associated with shouting are not the primary factor in the deterioration of intelligibility; the frequency shifts appear to be only symptomatic of serious vocal distortions in shouting.

612.85

4188. REPRODUCTION AND IDENTIFICATION OF ELEMENTS OF AUDITORY DISPLAYS. I.Pollack and L.B.Johnson.
J. Acoust. Soc. Amer., Vol. 31, No. 1, 7-8 (Jan., 1959).

The identification of the frequency of a tone was examined under four training procedures. The training procedures attempted to determine whether identification of tonal frequency could be improved by attaching distinctive motor responses to elements of the display. For relatively short training periods, such procedures were little more effective than simply providing verbal information of the correctness of the identification.

612.85

4189. ON SOME POSTSTIMULATORY EFFECTS AT THE THRESHOLD OF AUDIBILITY. J.Zwislocki, E.Pirodda and H.Rubin.
J. Acoust. Soc. Amer., Vol. 31, No. 1, 9-14 (Jan., 1959).

Poststimulatory threshold shift was measured for 1000 c/s stimuli of varying duration and sensation level, turned on and off either without audible transients or abruptly. The measurement was performed by means of test stimuli of varying duration and following the prime stimulus at various time intervals. The results show that the poststimulatory threshold shift depends little on the duration of the test stimulus, but that it depends critically on the time interval between the termination of the prime stimulus and of the test stimulus. The poststimulatory threshold decreases as this time increases. The poststimulatory threshold increases with sensation level and it depends in a complex fashion on the duration of the prime stimulus. The time pattern of the threshold changes radically when a gradual cutoff of the prime stimulus is replaced by an abrupt one. Replacing the 1000 c/s tone by a random noise leads to the same result as an abrupt cutoff.

615.849.1 : 537.54

INVESTIGATIONS OF HIGH ENERGY ELECTRON BEAMS FOR USE IN THERAPY. See Abstr. 3587

612.85 : 534.781

4190. INTELLIGIBILITY OF PEAK-CLIPPED SPEECH AT HIGH NOISE LEVELS. I.Pollack and J.M.Pickett.
J. Acoust. Soc. Amer., Vol. 31, No. 1, 14-16 (Jan., 1959).

The effect of symmetrical speech peak clipping upon speech intelligibility in noise was examined. Over a wide range of conditions, intelligibility is independent of the level of peak clipping if the postclipping speech power is held constant. Peak clipping thus achieves protection of the ear against painfully loud speech without demanding a penalty of intelligibility. Indeed, under restricted ranges of conditions, peak clipping may actually improve intelligibility with a constant speech power.

TECHNIQUE . MATERIALS

669 : 537.311.33

4191. DIFFUSION CONTROL IN SILICON BY CARRIER GAS COMPOSITION. C.J.Frosch and L.Derick.
J. Electrochem. Soc., Vol. 105, No. 12, 695-9 (Dec., 1958).

A single heating process is described for producing controlled p—n and n—p—n diffused structures in silicon by changing the carrier gas composition during diffusion. The process is shown to depend on large changes in the rate of evaporation from a Ga_2O_3 source at a given temperature in carrier gases of different composition. The weight loss from a Ga_2O_3 source at a given temperature is quite large in reducing gases, extremely small in neutral gases, and essentially zero in oxidizing gases. The weight loss from a Ga_2O_3 source in reducing gases also decreases with increasing concentrations of water vapour in the carrier gas. The weight loss from a Sb_2O_4source at a given temperature is relatively large in all of these carrier gases. The diffusion apparatus consists essentially of a fused silica tube extending through separately controlled temperature zones for the location of the diffusant sources and the silicon samples. Carrier gases at controlled rates of flow carry the diffusant vapours past the silicon samples at atmospheric pressure. Data are presented for single diffusions from Ga_2O_3 and Sb_2O_4 sources in several carrier gas compositions. P-type layers are formed in 5 ohm cm n-type silicon in the Ga_2O_3 diffusions in reducing gases but not in oxidizing gases. A controlled number of gallium atoms can be introduced into silicon by heating first in a reducing gas and then in an oxidizing gas. N-type layers are formed in 5 ohm cm p-type silicon in the Sb_2O_4 diffusions in all of the carrier gases studied. Data also are presented on double diffusions from As_2O_3—Ga_2O_3 and Sb_2O_4—Ga_2O_3 sources to illustrate the control of layer thickness by heating first in wet N_2 and then in wet H_2. These double diffused structures are shown to be suitable for the fabrication of high alpha transistors.

669.09 : 548.5

4192. ELECTROLYTIC SAW. M.Metzger.
Rev. sci. Instrum., Vol. 29, No. 7, 620-1 (July, 1958).

Strain-free cutting of metallic crystals at moderate rates can be obtained by localized electrochemical dissolution using a wire cathode. The width of the attacked zone is limited by applying a protective plastic film. Clean sharp cuts cannot generally be expected.

PHOTOGRAPHY

771.376 : 535.242.2

4193. A PHOTOMETRIC-WEDGE EXPOSURE METER.
Rev. Opt., Vol. 37, No. 2, 104-5 (Feb., 1958). In French.

This visual brightness meter is designed for use in micro- and macro-photography over a very wide range of luminance values (100 000/1). The variable comparison field is provided by a tungsten filament light-source modulated by a sliding neutral optical wedge.
D.R.Barber

778.34

4194. DESENSITIZATION OF ILFORD G5 PLATES WITH HYDROGEN PEROXIDE VAPOUR. A.Papkow.
Z. Naturforsch., Vol. 11a, No. 9, 758-9 (1956). In German.

To remove electron sensitivity without reducing proton sensitivity or stability to fading of the latent image, treatment with the saturated vapour from 4% H_2O_2 solution at 37°C for $\frac{1}{2}$hr or more was found satisfactory. Ilford C2 plates lost proton sensitivity by this treatment.
S.T.Henderson

778.344 : 535.371

4195. APPLICATION OF INORGANIC PHOSPHORS TO INFRARED PHOTOGRAPHY. H.Kallmann and J.Rennert.
J. Opt. Soc. Amer., Vol. 48, No. 11, 812-15 (Nov., 1958).

The utilization of zinc cadmium sulphide phosphor plates to depict objects with infrared radiation is described. Radiation in the near and middle infrared, between 0.7 to 2.5 microns produces latent images on phosphors for subsequent visual observation or permanent photographic record. The sensitization consists of uniformly populating traps by excitation of the entire phosphor plate. The infrared radiation to be depicted, decreases the trap population of the phosphor corresponding to the intensity distribution of the incident beam. This results in a latent image. The latter is then developed (made visible) by exciting the entire phosphor plate which results in a visible, transient, negative fluorescence image. With phosphors which exhibit any degree of visible stimulated luminescence, irradiation with short-wave ($\cong 0.7\ \mu$) infrared can also develop the latent image. Sensitization, exposure, and development can be effected in rapid succession or after large time intervals (weeks) between steps.

778.37

4196. MILLIMICROSECOND KERR CELL CAMERA SHUTTER.
A.M.Zarem, F.R.Marshall and S.M.Hauser.
Rev. sci. Instrum., Vol. 29, No. 11, 1041-4 (Nov., 1958).

The instrument described is an electro-optical shutter of the Kerr cell type, and is intended for general laboratory use as a camera shutter at effective exposure times in the low millimicrosecond region. Using this shutter system, a series of photographs of exploding wires has been made at an effective exposure time of 5 $m\mu$sec. The Kerr cell has an areal aperture of 2 × 4 cm at its smaller end and an apparent angular aperture of 20°, and is hermetically sealed. The required driving voltage pulse has an amplitude of 35 kV; the synchronizing network allows the shuttering action of the Kerr cell to be synchronized with the phenomena to be studied within less than 1 $m\mu$sec. The utilization of improved switching techniques shows great promise in attaining effective exposures in the submillimicrosecond region.

LIST OF JOURNALS

The following list supplements the List of Journals published with the Index to Volume 61 (1958). Reprints of the List of Journals can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

An. Stiint. Univ. "Al.I.Cuza" Iasi	Analele Ştiinţifice ale Universitătii "Al.I.Cuza" din Iasi. Secţiunea I (Matematică Fizică, Chimie). Jassy.
Bull. Fac. Engng (Cairo)	Bulletin of the Faculty of Engineering. Cairo University Press, Cairo.
Bull. Yamagata Univ.	Bulletin of the Yamagata University (Engineering Science, Natural Science). Yamagata.
Colloq. Astrofis. (Suppl. Mem. Soc. Astron. Ital.)	Colloqui del Centro di Astrofisica del Consiglio Nazionale delle Ricerche (Supplementi alle Memorie della Società Astronomica Italiana). Società Astronomica Italiana, Via Brera 28, Milan.
Contrib. Inst. Roy. Meteorol. Belgique	Contributions. Institut Royal Météorologique de Belgique. 3 Avenue Circulaire, Uccle-Brussels.
Electronic Applic.	Electronic Applications. (Formerly: Electronic Application Bulletin). N.V. Philips' Gloeilampenfabrieken, Eindhoven.
J. Univ. Saugar	Journal of the University of Saugar, Part II, Section A. The University, Saugar, M.P., India.
Mem. Fac. Engng Kobe Univ.	Memoirs of the Faculty of Engineering, Kobe University. Nagata-ku, Kobe.
Monogr. Res. Inst. Appl. Elect.	Monograph of the Research Institute of Applied Electricity. Hokkaido University, Sapporo.
Proc. Math. Phys. Soc. Egypt	Proceedings of the Mathematical and Physical Society of Egypt. Faculty of Science, Cairo University, Cairo.
Rep. Arts Sci. Fac. Shizuoka Univ.	Reports of Liberal Arts and Science Faculty Shizuoka University (Natural Science). Ôiwa 2, Shizuoka.

NEW JOURNAL

Regelungstech. Praxis	Regelungstechnische Praxis [Published as a Supplement to Regelungstechnik]. R.Oldenbourg, Rosenheimer Strasse 145, Munich. Quarterly. Vol. 1, No. 1 dated 1959.

CHANGE OF TITLE

Electronic Applic. Bull.	Electronic Application Bulletin. Title changed to: Electronic Applications [Electronic Applic.].

ERRATA

Author Index (1956) p. 1103, column 2, Penning,P. : for "7400"
read "7409".
Abstr. 2601 (1959) line 5 : for "geometrics" read "geometries"
line 6 : for "cf" read "i.e."
Abstr. 2049 (1959) line 6 : for "315" read "3.5"

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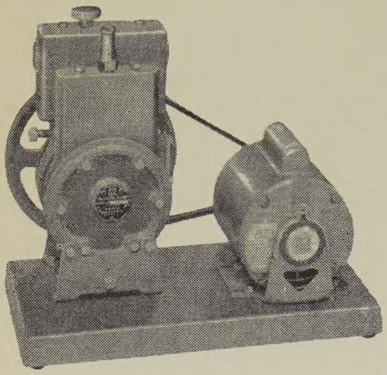

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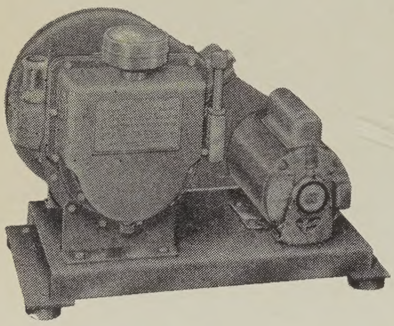

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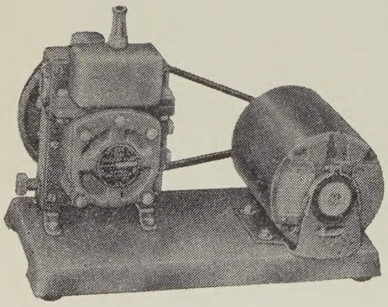

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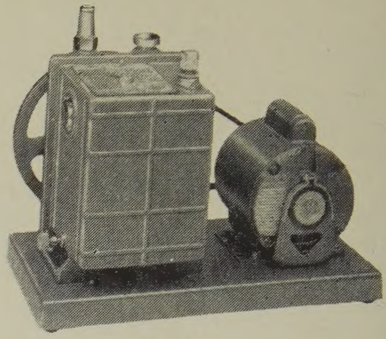

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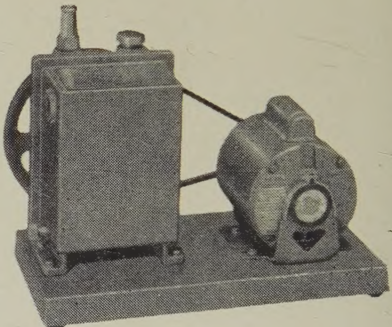

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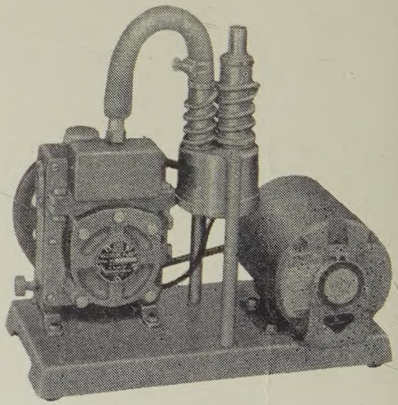

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